Australasian Plant Conservation

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Featuring articles on plant responses to fire, *ex situ* conservation, myrtle rust and more!

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Front cover: RTBG volunteer Laura Carvalho 'buzz' pollinating *Tetratheca gunnii*. Photo: James Wood

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From the editor

HEIDI ZIMMER

Days are getting warmer and much of our Australian flora is beginning to flower, and with this we bring you the spring edition of APC.

We begin with a timely article from Stephen Bell which discusses the challenges which arise from the increasing trend of botanists logging their observations on databases, rather than collecting voucher specimens. Bell highlights the importance of collecting voucher specimens, especially when the observation is new or rare in the region. Next, we travel to Western Australia, where Eddy Wajon shares the results of his long-term studies of the impacts of fire on the diverse woodland flora of his property.

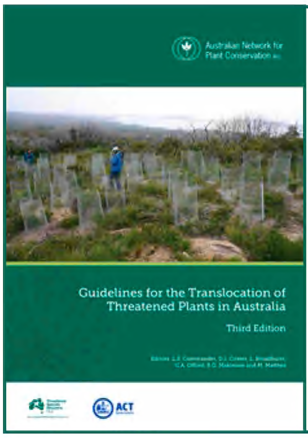
In this issue, we have five case studies prepared for the current revision of the ANPC's Germplasm Guidelines. The authors share valuable insights into the collaboration, planning, time and ingenuity that go into *ex situ* conservation of our national "plant treasures". This collection also highlights the strong and diverse skill set of scientific horticultural experts in Australia and New Zealand and their important role in our workplaces.

James Wood and Lorraine Perrins share their experience of lab germination and nursery seed production, respectively, at the Royal Tasmanian Botanical Gardens, both involving significant volunteer contributions.

Seed production is a theme carried over into Veronica Viler's case study on *Rhodomyrtus psidioides* at the Australian Botanic Garden Mount Annan, with cuttings and viable seeds obtained for this species which is severely affected by Myrtle Rust. Protecting developing fruit from the local bird population features in both articles on seed orchards! The complexity of planning and handling Myrtle Rust-susceptible material is illustrated again by Rebecca Stanley and Emma Bodley at Auckland Botanic Garden. Rebecca (Bec) has played a valuable role eliciting additional case studies for the Germplasm Guidelines from *ex situ* conservation specialists in New Zealand. The importance of collaboration for improved conservation outcomes is key to the case study on *Grevillea renwickiana* by Edward 'Joe' McAuliffe from the Australian National Botanic Gardens, with multiple government agencies and conservation practitioners working together to establish and expand *ex situ* collections informed by genetic analysis.

Concise versions of these case studies will be included in the 3rd edition of the Germplasm Guidelines, due mid-2021. For more information: https://www.anpc.asn.au/germplasm-guidelines-review/

We round out this issue with our regular features, including news from the Australian Seed Bank Partnership, a member profile from our ANPC new committee member Lydia Guja, a book review, news and conferences and research roundup.



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Voucher specimens vs observation records: why ‘collecting’ is better than ‘observing’ for plant conservation

STEPHEN A.J. BELL

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Prior to the availability of computers and databases, the collection and pressing of plant specimens (‘vouchers’) was the principle method of recording species distributions. Quite literally, these collections would ‘vouch’ for a claim, and provide tangible evidence that a certain taxon was present at a stated location on a specific day. These voucher specimens would take on elevated importance if they were lodged at a recognised herbarium where with the right curation they would last indefinitely. Such specimens have been the ‘bread and butter’ of botany and taxonomy for a long time, and their value has increased considerably in recent decades as conservation ecology has developed. However, with advances in computing and the development of digital databases there is a growing trend to simply *report* observations of species occurrence, rather than *collect* and lodge specimens with herbaria. Understandably, this is done to provide efficiency in plant surveys, but by improving work flow in this manner it is also constraining future management of our native flora. A recent field survey conducted in the Hunter Valley of New South Wales provides a case study of the potential implications of poor vouchering.

Hunter Valley grassy woodlands

A plot-based survey in the grassy woodlands of the upper Hunter Valley undertaken in April-May 2020 was able to capitalize on good rainfall that fell after prolonged drought. The diversity and abundance of plant species evident in these formerly barren and species-poor lands was outstanding, and lent considerable credence to the claims of early explorers in the region that the native pastures were waist high with ‘luxuriant fields of grass six feet high’. Just months earlier, these grasslands and grassy woodlands supported only a short crop of resilient grassy tussocks with numerous bare earth patches, but little-to-no herbs or forbs. Many of the species observed during this autumn period had not been seen for many years, and while this is not unusual in landscapes where plant life is driven by rainfall, it none-the-less regularly surprises even the most experienced of botanists.

While it is acceptable to report observation records of these sporadic fluxes in species diversity, it is far more important to ensure that voucher specimens of such rarely seen taxa are lodged at herbaria. A large number of species observed during this recent survey had not been collected in the Hunter Valley for many decades (see Table 1). Some were last collected from the region over 100 years ago: *Eclipta platyglossa* in 1913, *Rhynchosia minima* in 1909, and *Verbena gaudichaudii* in 1912. Yet, inspection of the NSW Bionet observation database for these species showed between 10 and 20 records for each of these over the period 2001 to 2017. *Themeda avenacea* (Figure 1), a tall grass that likely dominated much of the Hunter prior to European settlement as it did on the adjacent Liverpool Plains (Lang 2008), was last collected from the region in 1960 but has been observed as recently as 2017. It is of course pleasing that these species still remain in the area given the extent of change that has occurred in the Hunter over this period, but with no voucher specimens present in herbaria there has been no proof that those species remained extant.

Three species (*Panicum buncei, Teucrium betchei, Vittadinia pterochaeta*) recently observed have, according to Australia’s Virtual Herbarium (AVH), never been collected in the Hunter region. However, the NSW Bionet database (a database for biodiversity information managed by the NSW Government; bionet.nsw.gov.au) shows three observations (2010 to 2018) for *P. buncei*, four observations (2003 to 2011) for *T. betchei*, and >25 observations (2001 to 2014) for *V. pterochaeta*. The rise in botanical exploration in the Hunter over the past two decades to satisfy development assessment demand has inevitably increased detection of these species, and perhaps they may have always been present. However, no voucher specimens have ever been lodged so it is difficult to determine with confidence if these species are recent arrivals or original inhabitants. *Vittadinia pustulata*, a very common component of derived native grasslands in the recent surveys, has been vouchered only twice (the most recent more than 25 years ago), but the >30 observation records present in Bionet (1998 to 2018) tell a different story. Many species from the recent Hunter survey show discrepancies between observation records and vouchered specimens (Figure 2): Plains Grass (*Austrostipa aristiglumis*) has been observed nearly 600 times, but has been lodged in herbaria on only ten occasions.

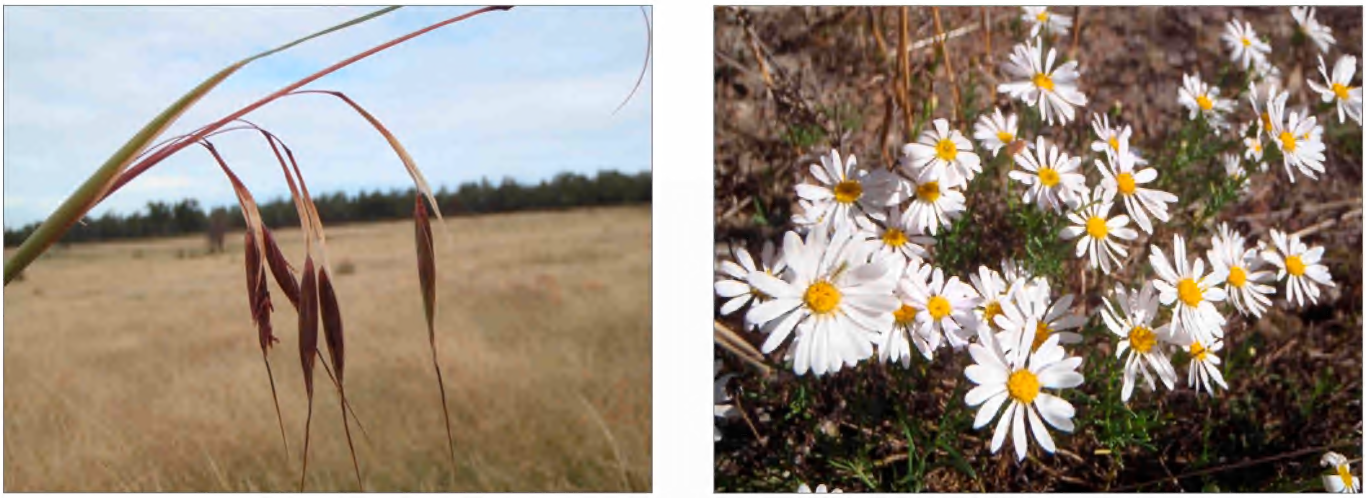

Figure 1. ***Themeda avenacea*** **(left) collected only four times from the Hunter Valley (the last in 1960), and** ***Minuria leptophylla*** **(right), a common component of Hunter grasslands and woodlands but collected only eight times (the last in 1999). Photos: Stephen Bell**

Table 1. Hunter Valley collection history and observation records of selected taxa (Source: AVH and NSW Bionet, accessed 19 May 2020). Filtered by Hunter-Central Rivers CMA region.

Family	Species	Collection history (AVH)	No. observations (Bionet)
Amaranthaceae	*Alternanthera nana*	1974, 1982	37
Apocynaceae	*Parsonsia lanceolata*	1963, 1985	58
Asteraceae	*Eclipta platyglossa*	1843, 1913, 1918, 1923, 1924, 1965, 1967, 1973, 1978, 1984, 1992, 2005	85
	Leiocarpa panaetioides	1843, 1924, 1969, 2009	5
	Minuria leptophylla	1883, 1907, 1908, 1948, 1949, 1965, 1968, 1999	81
	Solenogyne bellioides	1883, 1884, 1898	233
	Vittadinia cervicularis var. *subcervicularis*	1924	110
	Vittadinia gracilis	1955	15
	Vittadinia pterochaeta	no existing collections	53
	Vittadinia pustulata	1893, 1984	90
Boraginaceae	*Hackelia suaveolens*	1902, 1903, 1981	37
Campanulaceae	*Wahlenbergia luteola*	1970, 1992, 2003	176
Fabaceae	*Cullen tenax*	1949, 1967	43
	Rhynchosia minima	1843, 1907, 1908, 1909, 1994	73
Geraniaceae	*Erodium crinitum*	1883, 1913, 1969, 1991, 1995, 1998	258
Lamiaceae	*Teucrium betcheri*	no existing collections	10
Phrymaceae	*Mimulus gracilis*	1908, 1992	3
Poaceae	*Aristida leichhardtiana*	1980	19
	Austrostipa aristiglumis	1843, 1959, 1960, 1973	604
	Cymbopogon obtectus	1885, 1960, 1992	25
	Eragrostis sororia	1926, 1959, 1969, 1977, 1980	57
	Eulalia aurea	1843, 1908, 1914, 1924, 1959	220
	Panicum buncei	no existing collections	3
	Paspalidium aversum	1907, 1908, 1910, 1912, 1913, 1920, 1934, 1936, 1938, 1961, 1982, 1988, 2009	120
	Poa sieberiana var. *hirtella*	1914, 1959, 1991	7
	Sporobolus caroli	1902, 1995, 1999, 2007	40
	Themeda avenacea	1911, 1934, 1959, 1960	12
	Tragus australianus	1912, 1914, 1941, 1982	28
	Walwhalleya subxerophila	1991	6
Thymelaeaceae	*Pimelea curviflora* var. *sericea*	1883, 1992, 2000	166
Verbenaceae	*Verbena gaudichaudii*	1912	26

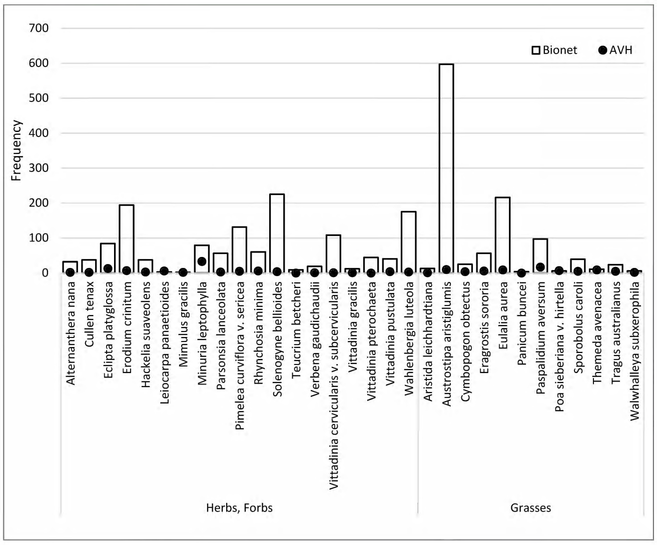

Figure 2. Frequency of selected Hunter Valley taxa in observational (Bionet) and collection (AVH) databases.

Why are vouchers important?

The trend evident in these examples is that observation records in the Hunter Valley (such as submitted to the Bionet database) have taken precedence over voucher specimens for the last two decades, if not longer. But why is this important? As noted earlier, without a voucher specimen there is no verifiable proof that a particular species was ever present at a location, and this can impact on new species discoveries and taxonomic revisions of species groups (*e.g.,* Bebber *et al.* 2010) and also on conservation assessments (*e.g.,* Rivers *et al.* 2011; Lughadha *et al.* 2018). Voucher specimens have been used to prepare species inventories and explore habitat loss (*e.g.,* Dolan *et al.* 2011; Kooyman *et al.* 2012), source propagules of threatened taxa (*e.g.,* Magrini 2011), prioritise conservation efforts (*e.g.,* Kricsfalusy and Trevisan 2014; Nualart *et al.* 2017), and monitor the changes in native and weed populations and morphology (*e.g.,* Borchert 1996; Heyligers 1998; Leger 2013). Debate over the humble European potato was even solved through examination of historical herbarium material (Ames and Spooner 2008). Following the recent Hunter survey, the lack of voucher specimens suggested that several of the species included in Table 1 were very rare in the region and consequently of elevated conservation significance, and perhaps should be assessed as species of high importance within the region. However, viewing of observation database records paints a different picture which, while gratifying, is concerning because without vouchers these records still remain unverified.

Preparing and lodging voucher specimens is time consuming, and in the work of many botanists this task is low on the priority list. Consultant botanists, for example, rarely if ever have scope in project costings to undertake this seemingly unnecessary job. However, we will increasingly be reliant on voucher specimens to guide future management of plant species, particularly in regard to their conservation. Species that are abundant under current environmental and social conditions may quickly become rare in a landscape, and access to verifiable specimens to show the progression of perceived loss and to quantify threats will be important. Undertaking a conservation assessment for a specific taxon, such as in implementing the IUCN (International Union for the Conservation of Nature) criteria, will require access to both voucher specimen and observation databases, but greater reliance will always be placed on voucher collections as they provide a data source that can be easily verified. Not all voucher specimens can be correctly determined at the time of collection due to limited knowledge or infertile material (*e.g.,* Bell 2020), but if retained in a herbarium they can be re-determined and corrected far easier than observation records.

Voucher specimens are also of immense importance to the progression of taxonomy, and this is particularly the case in regions where land use change and degradation is rapid. Taxonomists reviewing particular plant groups often only have herbarium collections to base revisions on, and if these are absent from a region then misinformation ensues. Physical examination of plant specimens, dried or fresh, is often necessary to correctly diagnose differences between closely related taxa, and herbarium specimens will become increasingly critical in any such taxonomic review. But in this new era of information accessibility, herbarium specimens are also important for a range of other scientific pursuits, including biodiversity informatics, global change biology, geological exploration and DNA analyses (Brooks *et al.* 1977; Heberling *et al.* 2019). Voucher specimens lodged with herbaria can be used for countless other uses, and Funk (2004), Guerin (2013) and Lavoie (2013) have outlined many of these.

A way forward

To rectify the current situation, field botanists must get into the habit of collecting rarely seen plant species and lodging specimens with recognised herbaria. As noted above, preparing and lodging specimens can be time consuming and deciding which species to concentrate on will vary between botanists; field experience and familiarity with the AVH collections database will play a big part in knowing where to expend effort. Consultant botanists are often under tight deadlines with restricted budgets and may find it difficult to allocate time to do this, but for the future of plant conservation and their careers a way forward needs be found.

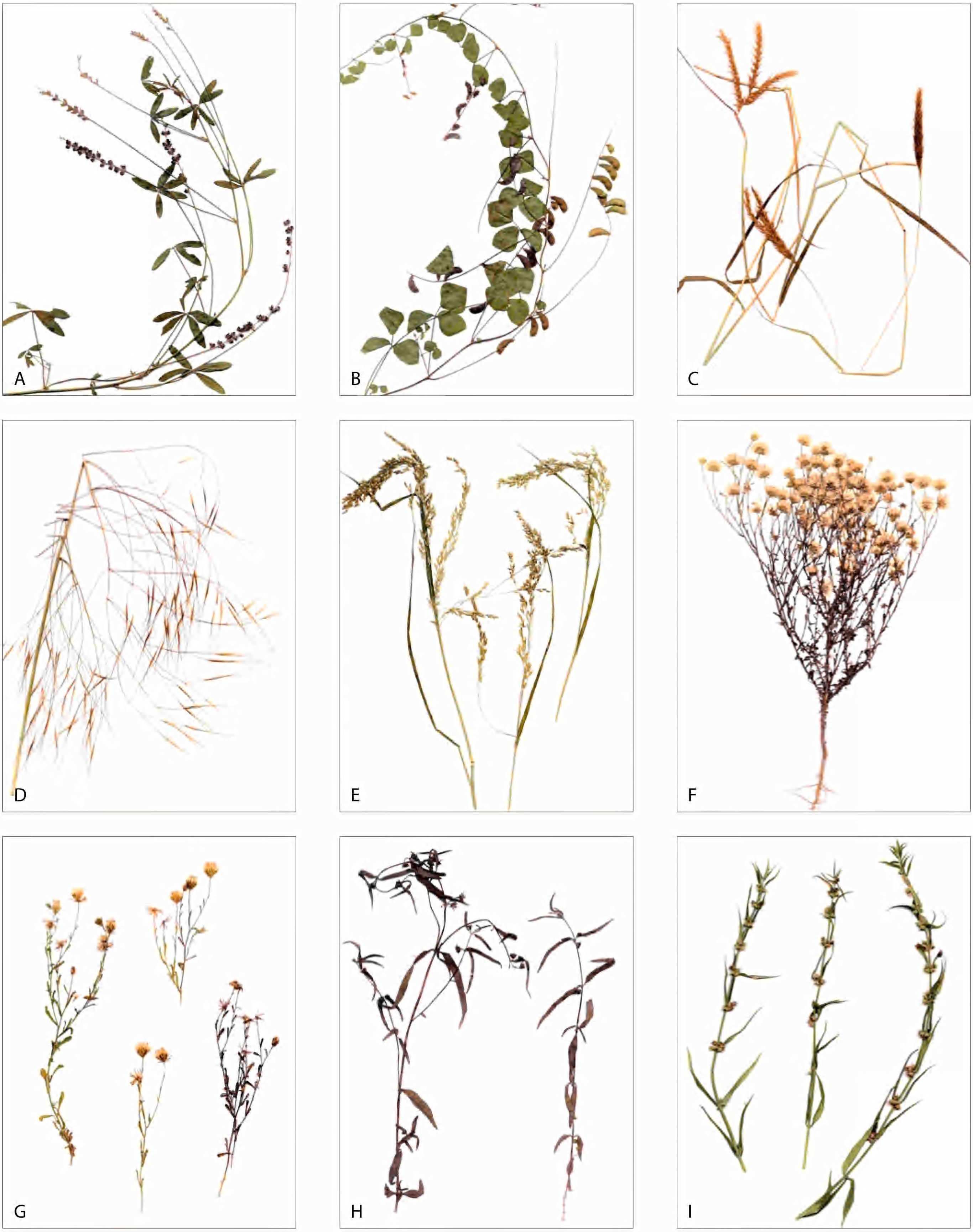

Figure 3. Examples of under-collected Hunter Valley taxa: (a) *Cullen tenax* (Fabaceae); (b) *Rhynchosia minima* (Fabaceae); (c) *Eulalia aurea* (Poaceae); (d) *Aristida leichhardtiana* (Poaceae); (e) *Panicum buncei* (Poaceae); (f) *Vittadinia pustulata* (Asteraceae); (g) *Vittadinia pterochaeta* (Asteraceae); (h) *Eclipta platyglossa* (Asteraceae); (i) *Teucrium betchei* (Lamiaceae). Images: Stephen Bell

References

Ames, M. and Spooner, D.M. (2008). DNA from herbarium specimens settles a controversy about origins of the European potato. *American Journal of Botany* 95: 252-257.

Bebber, D.P., Carine, M.A., Wood, J.R., Wortley, A.H., Harris, D.J., Prance, G.T., Davidse, G., Paige, J., Pennington, T.D., Robson, N.K.B and Scotland, R.W. (2010). Herbaria are a major frontier for species discovery. *Proceedings of the National Academy of Sciences* 107: 22169-22171.

Bell S. (2020). Check those IDs: the importance of confirming threatened plant identifications before implementing management. *Australasian Plant Conservation* 28: 18-20.

Borchert, R. (1996). Phenology and flowering periodicity of Neotropical dry forest species: Evidence from herbarium collections. *Journal of Tropical Ecology* 12: 65-80.

Brooks, R.R., Lee, J., Reeves, R.D. and Jaffre, T. (1977). Detection of nickeliferous rocks by analysis of herbarium specimens of indicator plants. *Journal of Geochemical Exploration* 7: 49-57.

Dolan R.W., Moore M.E. and Stephens J.D. (2011). Documenting effects of urbanization on flora using herbarium records. *Journal of Ecology* 99: 1055-1062.

Funk, V. (2004). 100 Uses for an Herbarium: well at least 72. *American Society of Plant Taxonomists Newsletter* 1-4.

Guerin, G.R. (2013). The value of herbaria to diverse collections-based research. *Australasian Systematic Botany Newsletter* 157: 43-44.

Heyligers, P.C. (1998). Some New South Wales coastal plant distributions: a comparison of herbarium records with transect survey data. *Cunninghamia* 5: 645-664.

Kooyman, R., Rossetto, M. and Laffan, S. (2012). Using Australian Virtual Herbarium data to find all the woody rain forest plants in Australia. *Cunninghamia* 12: 177-180.

Kricsfalusy, V.V. and Trevisan, N. (2014). Prioritizing regionally rare plant species for conservation using herbarium data. *Biodiversity and Conservation* 23: 39-61.

Lang, R.D. (2008). Defining the original extent and floristic composition of the naturally-treeless grasslands of the Liverpool Plains, North Western Slopes, New South Wales. *Cunninghamia* 10: 407-421.

Lavoie, C. (2013). Biological collections in an ever changing world: Herbaria as tools for biogeographical and environmental studies. *Perspectives in Plant Ecology, Evolution and Systematics* 15: 68-76.

Leger, E.A. (2013). Annual plants change in size over a century of observations. *Global Change Biology* 19: 2229-2239.

Lughadha, E.N., Walker, B.E., Canteiro, C., Chadburn, H., Davis, A.P., Hargreaves, S., Lucas, E.J., Schuiteman, A., Williams, E., Bachman, S.P., Baines, D., Barker, A., Budden, A.P., Carretero, J., Clarkson, J.J., Roberts, A., and Rivers, M.C. (2018). The use and misuse of herbarium specimens in evaluating plant extinction risks. *Philosophical Transactions of the Royal Society B* 374: 20170402. Available at: http://dx.doi.org/10.1098/rstb.2017.0402

Magrini S. (2011). Herbaria as useful spore banks for integrated conservation strategies of pteridophytic diversity. *Plant Biosystems* 145: 635-637.

Nualart N, Ibáñez N, Soriano I, López-Pujol J. (2017). Assessing the relevance of herbarium collections as tools for conservation biology. *Botanical Review* 83: 303–325.

Rivers M.C., Taylor L., Brummitt N.A., Meagher T.R., Roberts D.L., Lughadha E.N. (2011). How many herbarium specimens are needed to detect threatened species? *Biological Conservation* 144: 2541-2547.

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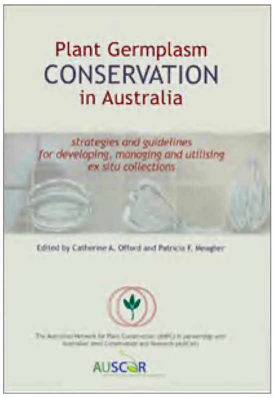

Plant Germplasm
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strategies and guidelines
for developing, managing and utilising
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AUSCOR

Response of native vegetation in the Great Southern region of Western Australia to fire

EDDY WAJON

Wajon Publishing Company, 16 Eckersley Heights, Winthrop WA.
Corresponding author: wajonpub@bigpond.com

Introduction

Fire is a natural part of the ecosystem in southwest Western Australia (WA). Native plants have a variety of responses to fire, ranging from germination of obligate seeder species from seed stored in the soil or released as a consequence of the fire, prompted by chemicals in smoke or other dormancy breakers, to re-greening of re-sprouter species from epicormic buds or lignotubers, to flowering or death. Fire needs to be diverse in terms of its intensity, scale, season and frequency to maintain flora biodiversity and enable all plants in the ecosystem to persist in the long term.

The time to first flowering and peak flowering are useful attributes for understanding how species and vegetation will respond to different fire regimes. A useful attribute for a species is the juvenile period, defined as the time required for 50% of the individuals of a population to flower. A 'rule-of-thumb' adopted by many fire managers to ensure persistence of all species in a community is that the shortest interval between fires, whether wild or planned, should be double the juvenile period of the slowest obligate seeder in the community (Burrows and Wardell-Johnson 2003). This is assumed to provide all obligate seeders with sufficient time to set adequate viable seed in the event that the original plants die, and to enable them to persist in that area. This strategy also assumes that re-sprouters successfully reproduce faster than obligate seeders after fire, and it allows for the vagaries of climate, especially drought.

There have been a number of studies determining the time to first flowering, time of peak flowering and the juvenile period of Western Australian native plants and impacts of fire in south-western WA including in regions such as the Central Wheatbelt and the Jarrah-Karri forest of the southwest (Burrows *et al.* 2008, Shedley *et al.* 2011, Harvey *et al.* 2017, Bradshaw *et al.* 2018, Shedley *et al.* 2018). This article describes the fire attributes of native plants on a patch of remnant bushland in the Great Southern region of WA, and the consequences of its fire history on the vegetation.

Background

In December 2002, my wife and I purchased the 46ha bush property Mondurup View in Tenterden in the Great Southern area of WA (see Figures 1 and 2). The property had never been cleared or grazed, and the purpose of our purchase was to conserve it as such in perpetuity. Our intentions were to enjoy its attributes, especially its abundant orchids, to photograph, identify and document as many of the flora, fauna and fungi on the property as possible, and to share it with family, friends and the community as an environmental education tool.

The property consists of several different plant communities, including a *Eucalyptus wandoo* (Wandoo) woodland, *Eucalyptus marginata- Corymbia calophylla* (Jarrah-Marri) woodland, *Eucalyptus decipiens* (Redheart-Moit) mallee-heath, *Allocasuarina huegeliana* (Rock Sheoak) woodland and *Eucalyptus cornuta* (Yate) riverine woodland along an upstream reach of the Young River. Over the almost 18 years of our ownership, we have documented 354 native flora taxa on the property. Nearly 200 of these taxa occur in eight major families as follows:

- Orchidaceae: 52
- Proteaceae: 33
- Fabaceae (including Acacia): 31
- Myrtaceae: 29
- Asteraceae: 17
- Cyperaceae: 15
- Ericaceae: 13
- Goodeniacea: 9

In December 2003, only 1 year after our purchase, an intense wildfire, started by clashing power lines 15 km to the west, swept through the entire property. The fire incinerated all the vegetation, except a metal shed, which served as our accommodation and was surrounded by a 20 m wide fuel-free zone, which survived virtually intact even though the temperature inside the shed was sufficient to vaporise a foam mattress. Following the fire, we attempted to determine the response of the flora to the fire by documenting the time to first flowering of as many of the native species recovering from the fire as possible. We also documented the recovery of, and the impact of the fire on, the vegetation overall. The intent of gathering this data was to provide information that might assist in determining the most appropriate fire management strategies and fire interval for similar vegetation throughout the Great Southern region of WA.

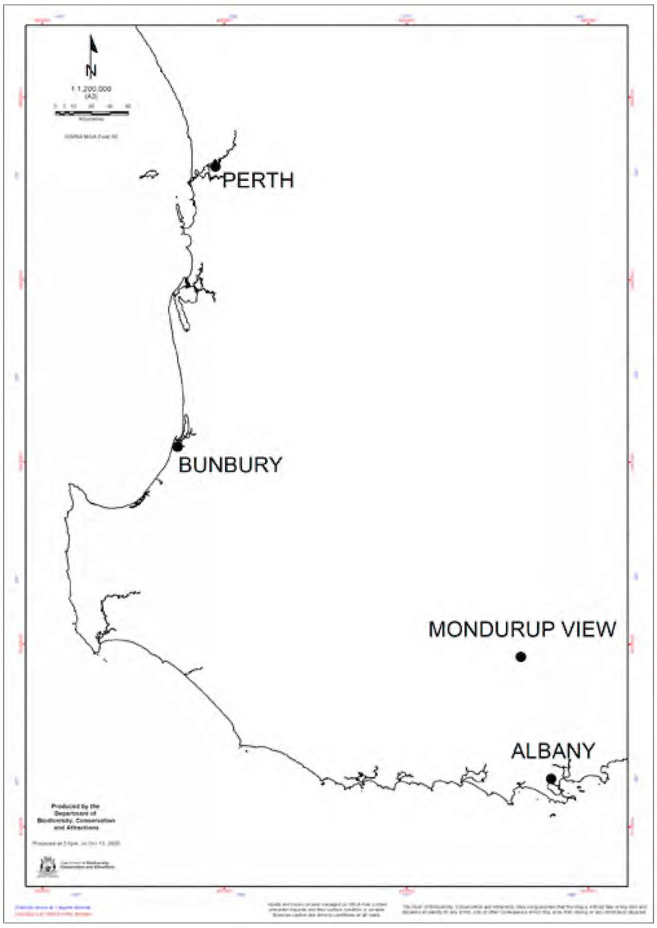
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Figure 1. Location of Mondurup View in Western Australia.

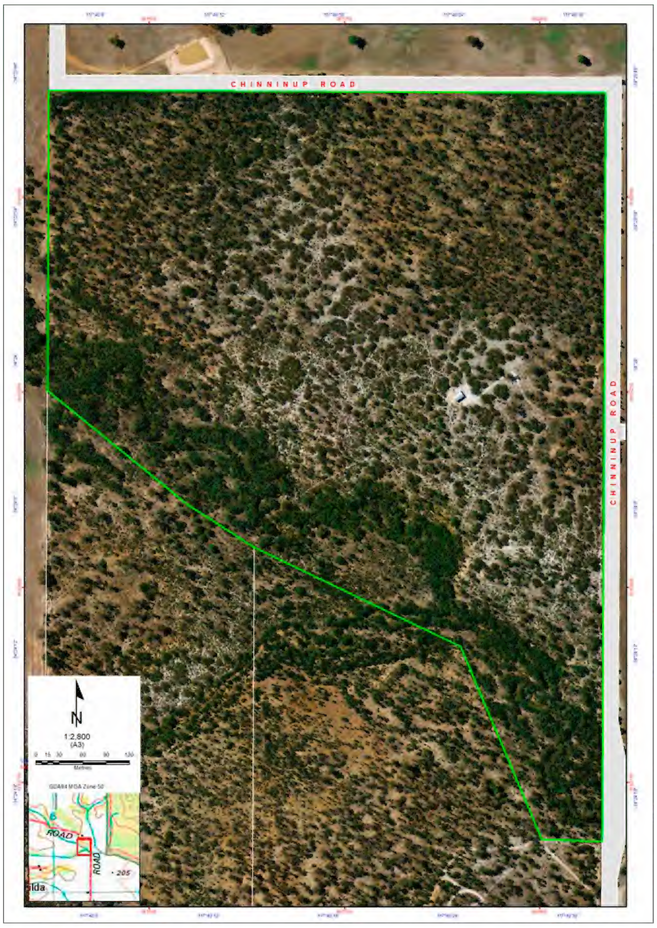

Figure 2. Location, aerial view and boundary (green line) of Mondurup View in Tenterden in 2019.

Methodology

Mondurup View was visited approximately six times per year (mostly corresponding to WA public holiday long weekends) between January 2004 and May 2020. The property was explored by walking along six marked trails radiating from the accommodation shed to each of the boundaries of the property, as well as by walking along parts of each boundary. In addition, areas of the property were explored opportunistically. During these walks, plants in flower were actively sought and examined. Photographs and specimens of plants were taken before the fire, and again after the fire when they reached first flowering. For each taxon observed in flower for the first time since the fire, the location, morphological characteristics, presence of fruit after flowering (if obvious), total number of plants and number of plants in flower within a radius of 20 m, were recorded. Specimens of most plants were lodged with the WA Herbarium, and duplicate specimens were kept to create a Field Herbarium. Plants were identified to species and subspecies level either by me with the aid of keys and reference specimens, or by WA Herbarium staff following lodgement of specimens.

Eight photo monitoring points were established throughout the property after the fire. Three to six photos of the overall vegetation were taken at right angles to each other at each of these sites 2 months and 1, 3, 4, 5, 6, 7, 8, 9, 10 and 16 years after the fire. In addition, opportunistic photos were taken of the vegetation and of individual trees, both dead and alive, over the 17 years since the fire.

Response of plants species to fire

During the twelve months from December 2002, when the property was purchased, to the fire in December 2003, photographs and/or specimens were taken of 54 plant taxa. Subsequent to the fire, many more species were recorded that had either not been present or were not recorded prior to the fire.

In the 17 years since the fire, 342 of the currently known 354 taxa (about 96.5%) have flowered, the last flowering 15 years after the fire. Of these, the exact time to first flowering is known for 279 taxa, or about 79% of the total taxa. Another 64 species flowered for the first time between 2003 and 2020, but the exact time to first flowering is not known. Of these, 27 taxa flowered for the first time sometime within the first 5 years and another 27 flowered for the first time sometime in the 5-10 years after the fire. For nearly all taxa, the time to first flowering was also the juvenile period *i.e.,* at least 50% of the individuals of the population flowered at the time of first flowering.

A plot of the cumulative proportion of the total number of taxa that have flowered since 2003, with known time to first flowering, against the time to first flowering, is shown in Figure 3. The data indicate that more than 50% of taxa had flowered after 5 years, but it took 15 years for 96% of the 354 species at Mondurup View to flower. Amongst the first species to flower was the grass *Austrostipa flavescens* which had not been seen before the fire and has not been seen since the first year after the fire. Tall, structurally important Eucalypt species resprouted from basal and/or epicormic buds and then flowered and set seed. Time to first flowering for *Eucalyptus marginata* was 11 years, while *Eucalyptus wandoo* (6 years), *Eucalyptus cornuta* (4 years) and *Corymbia calophylla* (6 years) flowered more quickly. Time to first flowering for tall, structurally important re-seeders was also long, *e.g. Allocasuarina huegeliana* (10 years) and *Acacia acuminata* (12 years), as it was for some medium-sized woody re-seeder shrubs, *e.g., Persoonia striata* (11 years) (see Figure 4), *Petrophile crispata* (12 years) (see Figure 5), *Pimelea lehmanniana* (13 years) and *Acacia cochlearis* (15 years). Surprisingly, some small perennials and geophytes such as *Argentipallium niveum* (14 years), *Drosera androsacea* (10 years), *Dampiera lavandulacea* (10 years) and *Comesperma ciliatum* (9 years) also took a long time to flower.

Two species (*Acacia cochlearis and Amyema miquelii*) only flowered for the first time in 2018, 15 years after the fire, and one species (*Macrozamia reidleii*) has not been seen to flower or fruit. Two species, *Petrophile phylicoides* and *Caladenia macrostylis*, of which only 1 individual of each species was seen before the fire, have not been seen since the fire, and are now considered extinct on the property.

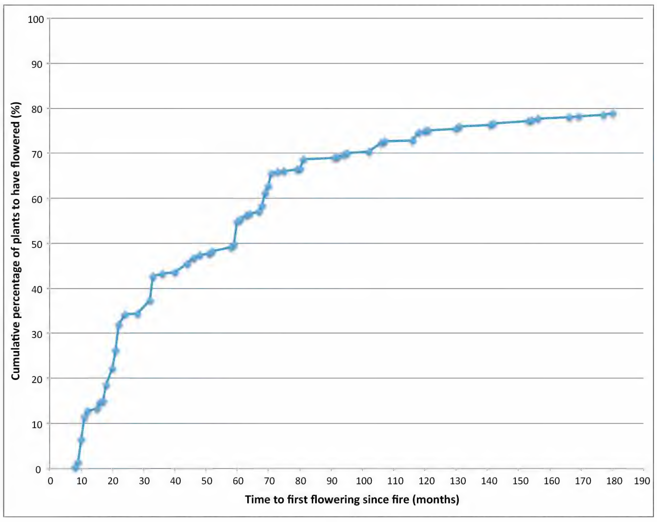

Figure 3. The cumulative proportion of the total number of taxa known to be present at Mondurup View against the time to first flowering after the fire in December 2003.

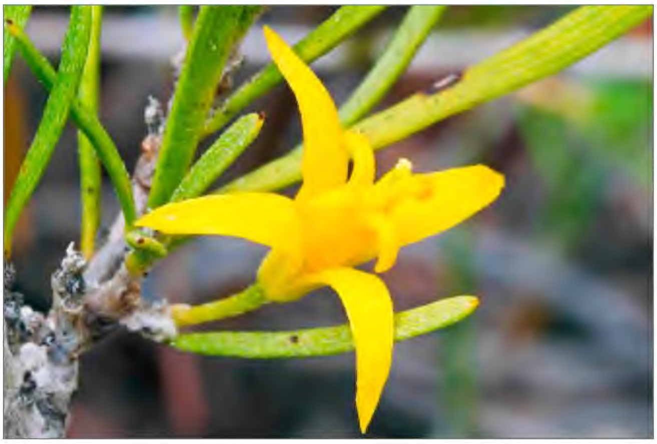

Figure 4. *Persoonia striata* flowering for the first time 11 years after the 2003 fire. Photo: Eddy Wajon

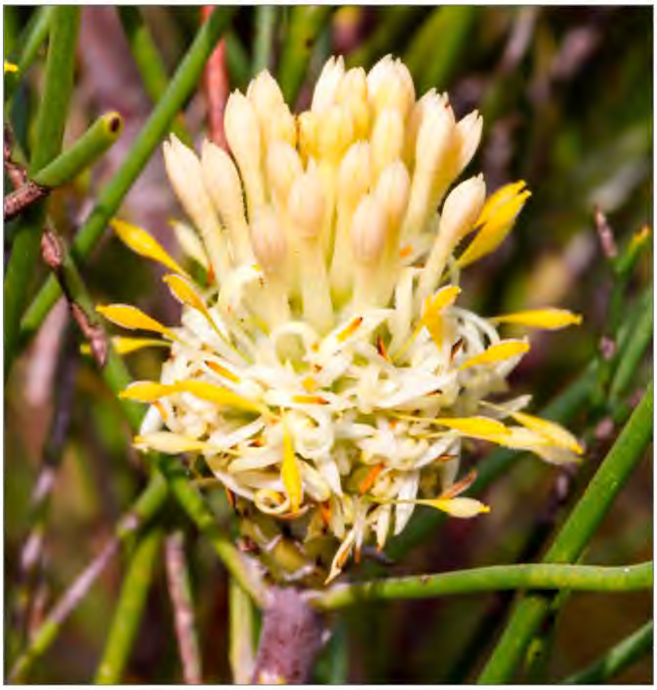

Figure 5. *Petrophile crispata* flowering for the first time 12 years after the 2003 fire. Photo: Eddy Wajon

The results from this study should be compared with the results from the Jarrah-Karri forest of the far southwest of WA (average rainfall 750-1300 mm) (Burrows *et al.* 2008) in which all of the 639 species observed reached flowering age between 3 and 5 years after fire. In the Tutanning Nature Reserve in the Avon Wheatbelt (average rainfall 445mm) (Harvey *et al.* 2017), just over 50% of the 181 species observed flowered within 1.5 years, and 98% of species had flowered by 7.5 years. The time for recovery of species at Mondurup View in the Great Southern of WA (average rainfall 727 mm) thus appears to be 2–3 times longer than in some other parts of the southwest of WA. This may be in part because the fire in the Tutanning Nature Reserve was a cool fire (Harvey, J., personal communication), whereas the fire at

Mondurup View was a hot fire. This suggests that there is a risk of local species extinction if fire intervals shorter than 6–15 years were used in moderate or hot prescribed burn regimes in the Great Southern.

Response of vegetation to fire

Apart from the effect of fire on species, fire can have a great effect on individuals of species and the overall state of the vegetation that recovers from the fire. The vegetation at Mondurup View is still recovering from the 2003 fire with many stags (dead limbs/trunks) visible above the treetops and continuing to fall to the ground. Further, the 2003 fire killed many large, old Jarrah, Marri, Wandoo and Yate trees. Many of these may have been hollow-bearing, and while some have remained standing, others have fallen and are no longer suitable as nesting hollows to arboreal fauna such as Carnaby's Black Cockatoo, Brush-tailed Possums and Brush-tailed Phascogales which are known to be present on Mondurup View.

Of equal, or even greater concern, is the accumulated impact of intense fires. Prior to our purchase, Mondurup View suffered an intense wildfire in 1980/1981 that was caused by a fire on a power line pole-top insulator. There are also reports of wildfires around Tenterden in 1919, 1930, 1941, 1946 and 1950, but it is not clear whether these affected Mondurup View. However, the presence of many large, dead, 20m tall, standing and fallen Yate, Marri and Wandoo trees with trunk diameters of 1-1.75 m along the Young River and in the Wandoo and Jarrah-Marri woodland (see Figure 6), even before the 2003 wildfire, suggests that there have been a number of intense wildfires at Mondurup View.

This succession of presumed intense fires in the last 50-100 years has significantly shaped the vegetation and landscape at Mondurup View. What we now have are regenerating, coppicing, mallee forms of Yate along the Young River, and a preponderance of young, small-trunked Wandoo, Jarrah and Marri in other parts of the property. This has resulted in a lack of usable nesting hollows for Black Cockatoos and other large fauna, as well as diminished ambience compared to the presumed former well-spaced, single-trunked giants.

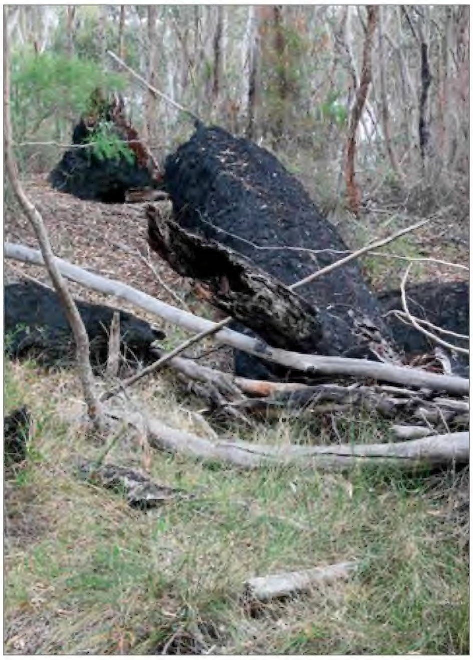

Figure 6. Fallen trunk of *Corymbia calophylla* with 1.75 m diameter along the Young River. Photo: Eddy Wajon

Conclusions

The presence of many large, dead, standing and fallen trees at Mondurup View suggests that prior to European colonisation and clearing of the Wheatbelt and Great Southern of WA, mature, large, well-spaced Eucalypts were common in the landscape. This was presumably because of the absence of infrequent, large-scale, hot, catastrophic fires, possibly controlled through frequent, small-scale, cool to moderate fires. However, given the long juvenile period of many small, woody native species (10-15 years) determined in this study, it is unclear how they survived in such a frequent fire regime to still be present today, unless in such burning regimes, the adult plants are not killed, or at least not all are killed. On the other hand, it seems local extinction of small woody species can also occur with infrequent, hot fire regimes.

Contrary to expectations, this study raised more questions than it answered about the most appropriate fire regime(s) required to maintain biodiversity. Consequently, more long-term longitudinal and chronological studies need to be undertaken in different vegetation communities to address these issues.

References

Bradshaw, S.D., Dixon, K.W., Lambers, H., Cross, A.T., Bailey, J., and Hopper, S.D. (2018). Understanding the long-term impact of prescribed burning in Mediterranean-climate biodiversity hotspots, with a focus on south-western Australia. *International Journal of Wildland Fire* 27(10): 643-657.

Burrows, N.D., Wardell-Johnson, G., and Ward, B. (2008). Post juvenile period of plants in south-west Australia forests and implications for fire management. *Journal of the Royal Society of Western Australia* 91: 163-174.

Harvey, J.M., Hopkins, A.J.M., Langley, M.A., Gosper, C.R., Williams, M.R. and Yates, C.J. (2017). Long-term studies of post-fire reproduction in an Australian shrubland and woodland. *Australian Journal of Botany* 65: 339–347.

Shedley, E., Burrows, N., Yates, C.J., and Coates, D.J. (2018). Using bioregional variation and fire response attributes as a basis for managing threated flora in a fire-prone Mediterranean climate biodiversity hotspot. *Australian Journal of Botany* 66: 134-143.

Shedley, E., Coates, D., and Burrows, N. (2011). Fire responses of threatened flora in Western Australia. *Australasian Plant Conservation* 19: 36-37.

Burrows, N., and Wardell-Johnson, G. (2003). Fire and plant interactions in forested ecosystems of south-west Western Australia. In *Fire in ecosystems of south-west Western Australia: impacts and management*. (pp. 225–268). Backhuys: Leiden, the Netherlands.

It's not all about the birds and the bees – Challenges and triumphs of Conservation Seed Orchards at the Royal Tasmanian Botanical Gardens

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Banking on success

One goal of the Tasmanian Seed Conservation Centre, based at the Royal Tasmanian Botanical Gardens (RTBG), is to have all of Tasmania's rare and threatened species and communities secured as long-term collections.

Some major challenges in achieving this are:

- 20% of Tasmania is remote Wilderness World Heritage with limited accessibility on foot, by air or sea.
- Many threatened species occur in remote or inaccessible areas, meaning monitoring for seed harvest can be difficult and very expensive.
- Some species occur in very small populations and/or occur sporadically across large areas making locating and harvesting difficult.

Developing 'Conservation Seed Orchards' often referred to as 'Field Genebanks' can provide a way to overcome some of these obstacles by providing ready access to genetically diverse collections. These are not without their own difficulties however, which can differ for individual sites and species, and need to be recognised and managed accordingly.

Since the RTBG's Nursery Seed Orchard Program began in 2006, 45 orchards have commenced, with 30 completed. The average time to run orchards from cuttings or germinants to a 'good' seed harvest *i.e.,* minimum of 10,000 seeds, is currently 7 years, and costs approximately $7,000 per species (roughly the same amount as one helicopter trip). However as more of the herbaceous or easily propagated species are completed, the cost and time is expected to increase as we move to slower growing and/or difficult to propagate species.

Trials and tribulations

Examples of some issues impacting the success of orchards at the RTBG are:

1. Understanding the biology

Tetratheca gunnii – This endemic Tasmanian species requires buzz pollination by a suitably-sized native bee (European honeybees being too large). Studies by the University of Tasmania (2017), discovered that the RTBG did not have sufficient native bees within its boundaries, primarily due to their short flying distance, lack of habitat, and human disturbance. All of Tasmania's bee species are solitary, unlike some hive-forming mainland species *e.g.,* Stingless Bees, which can be moved around. Hand pollination, with the assistance of volunteers, was attempted but proved ineffectual (Figure 1).

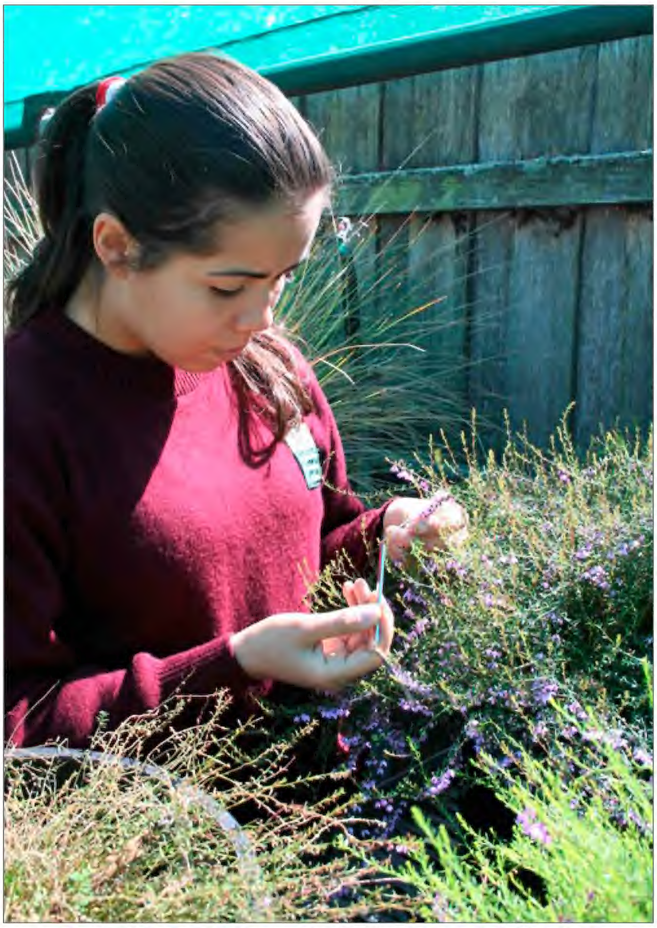

Figure 1. RTBG volunteer Laura Carvalho 'buzz' pollinating *T.gunnii*. Photo: James Wood

Activities to increase habitat and nesting sites within the Nursery and plans to introduce native bees are being enacted (Figure 2), as well as the temporary transportation of the seed orchard to higher bee density areas. Additionally, *Tetratheca* also not only releases seed over many weeks, but the seeds possess elaisomes (a structure composed of protein or fat) to attract ants in an effective dispersal strategy called myrmecochory. Measures to prevent loss of seed (*e.g.,* physical ant barriers) have also been implemented.

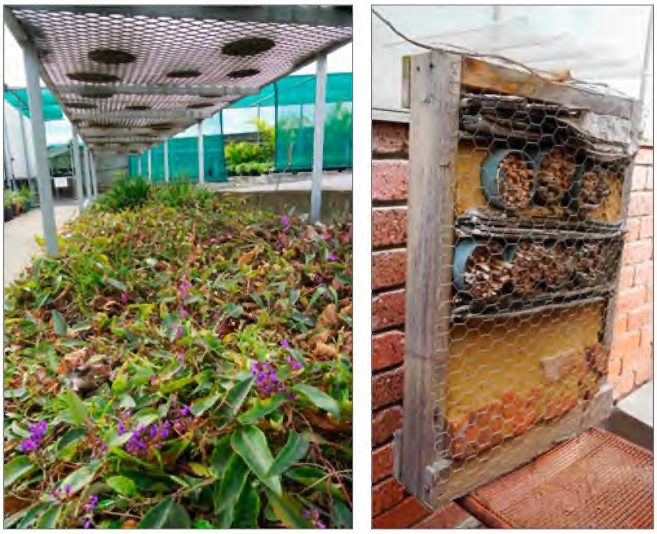

Figure 2. Under bench habitat plantings (left) and insect nest augmentation (right) to encourage pollinators to remain within the RTBG Nursery facility. Photos: Lorraine Perrins

2. Thinking outside the box

Azorella macquariensis: An endemic cushion plant on subantarctic Macquarie Island, this critically endangered species is being impacted by a severe dieback (Perrins 2012). The species is highly adapted to the harsh conditions on the island making it extremely difficult and costly to maintain in cultivation in Hobart. Despite several complex logistical challenges, *e.g.,* working on a remote World Heritage subantarctic island where supplies must be shipped via the annual Australian Antarctic Division's (AAD) supply vessel, an *ex-situ* collection/seed orchard has been successfully developed away from the wild populations (Figure 3). The collection is monitored via images sent from Parks and Wildlife Rangers based on the Island. Ten years on, this collection continues to thrive and is testament to the sustained cooperation between Botanic Garden staff, AAD, State Departmental scientists, and Tasmanian National Parks and Wildlife reserve managers.

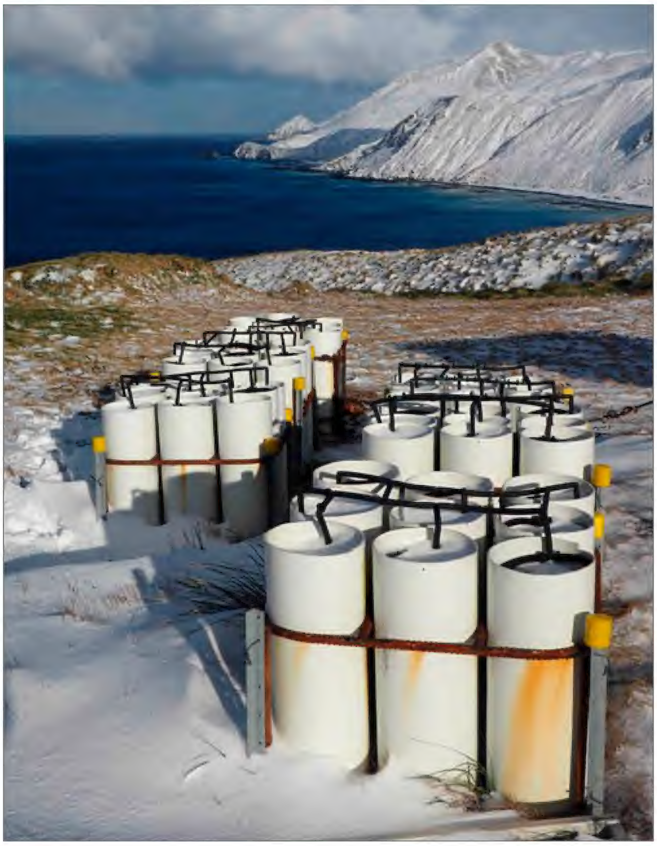

Figure 3. *Azorella macquariensis ex-situ* conservation collection and seed orchard on Macquarie Island. Photo: Andrea Turbett (TASPWS)

3. Expect the unexpected

Lessons have been learnt that assumptions should not be made on the ease of growing species for a seed orchard. An example of this was with two Tasmanian coastal herbaceous species, *Lepidium flexicaule* and *Veronica novae-hollandiae*. Both proved to be easily propagated and grew rapidly, producing flowers within a few months. However just as rapidly the *Lepidium flexicaule* orchard succumbed to an outbreak of White Rust (*Albugo candida),* a difficult-to-control disease which arrived in Australia in 2001 and affects members of the Brassicaceae family. Disease problems also occurred with the *Veronica novae-hollandiae* orchard, which despite growing in constantly wet environment dune habitat on the West Coast of Tasmania, proved to be very susceptible to Downy Mildew (*Peronospora* spp.). There also appears to be an issue with the fruit capsules of this species not ripening fully in cultivation which is still under investigation.

Some pest issues can seem minor but do need to be monitored. An example is that when the RTBG Seed Orchard Program began 14 years ago, the sparrow population in Hobart had been decimated by disease (Wildlife Health Australia 2018). It is only relatively recently that numbers of these seed-eating birds have increased to the point that they now severely impact some seed harvests, resulting in extra infrastructure protection being constructed (Figure 4). Good observation and the ability to adapt are key for successful seed orchards.

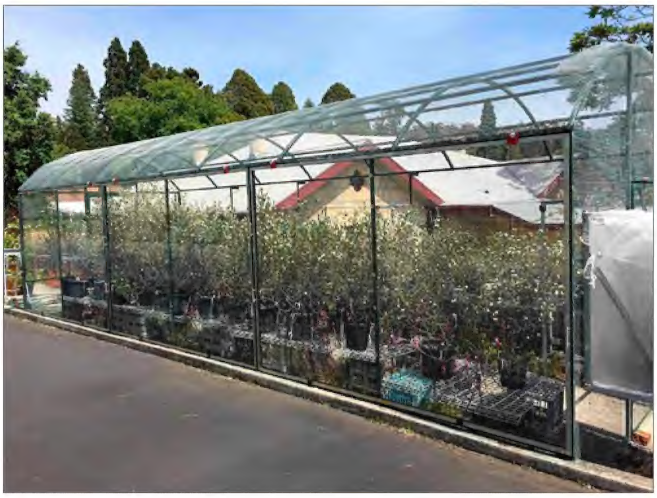

Figure 4. Bird-proof enclosures for seed orchards with removable sides to facilitate harvesting. Photo: Lorraine Perrins

Additional considerations made prior to the formation of a seed orchard include:

- Ensuring there is sufficient genetic diversity within the seed orchard.
- Ability to provide suitable growing requirements for species *e.g.,* potting media, environmental conditions.
- Ensuring differing species held do not hybridise, impacting the genetic integrity of the collections.
- Maintaining accurate records to monitor potential genetic erosion for longer term seed orchards if conditions favour more robust genotypes.
- Providing disease controls – some species can become more susceptible to diseases when grown artificially.
- Providing pest controls – predation by birds can decimate a crop in a few hours, or damage via from other wildlife *e.g.,* possums, can be a major issue. Pesticide usage to control insect pests may also negatively impact pollinators.
- Understanding the reproductive biology of species to determine effective pollination requirements and harvesting techniques *e.g.,* explosive seed capsules.
- Appreciating the time required for harvesting. Not all species can be bagged after flowering. Many species continue to flower and release seed over many weeks/months, requiring daily or more frequent hand collection, usually during peak summer holiday periods when volunteer assistance can be diminished.
- Understand and plan for the 'end use' of the orchard once complete *e.g.,* not using biological controls or soil inoculants on species that will be used for translocation purposes.

Satisfying rewards

The development of our orchard programs from cuttings or seed to productive, flourishing seed orchards can be challenging, however it has consistently provided much larger quantities of seed than could be collected from the wild populations. Additionally, the benefits of intimately observing and recording specific requirements of each species can reap much more than just the physical rewards.

References

Perrins, L. (2012). 'Azorella macquariensis' – battling for survival in the furious fifties. *Australasian Plant Conservation* 21(2):25-26.

University of Tasmania, Environment, Resource and Sustainability. (2017). '*Native bees best - Here's the buzz on why bees could save plants from extinction*' Available from: https://www.utas.edu.au/news/2017/6/22/328-native-bees-best/

Wildlife Health Australia. (2018). '*WHA Fact sheet:* Salmonella typhimurium *DT160 in house sparrows*'. Available from: https://wildlifehealthaustralia.com.au/Portals/0/Documents/FactSheets/Avian/Salmonella%20Typhimurium%20DT160%20in%20House%20Sparrows%20in%20Australia.pdf

Germination Testing at the Tasmanian Seed Conservation Centre

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The germination testing programme of the Tasmanian Seed Conservation Centre (TSCC) at the Royal Tasmanian Botanical Gardens (RTBG) began in August of 2006. At that time, we had two incubators and the programme was run solely by myself. Since 2006 the programme has grown to using 12 incubators and is almost totally performed by a team of eight volunteers, with myself orchestrating collections and conditions to be run. Tests are typically conducted on 9 cm petri dishes of 1% agar. These can either be plain water agar or agar with 0.01 M concentration of Potassium Nitrate or a 4% dilution of SmokeMaster Regen 2000. Those outside the discipline of seed science will be familiar with the role that smoke can have in promoting germination. Less well known is the potent effect that small amounts of nitrate can have as well. The levels used are typically available in bare soils but, need to be added to a test media to elicit germination. Our germination volunteer activity consists of setting up and scoring tests, as well as performing cut-tests at the end of trials. Determining testing regimes to be used on collections is overseen by myself, with the end point of achieving a greater than 75% germination result from the viable seed.

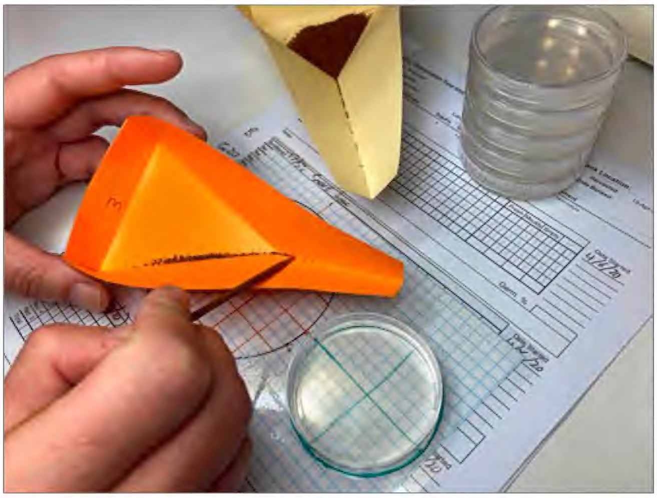
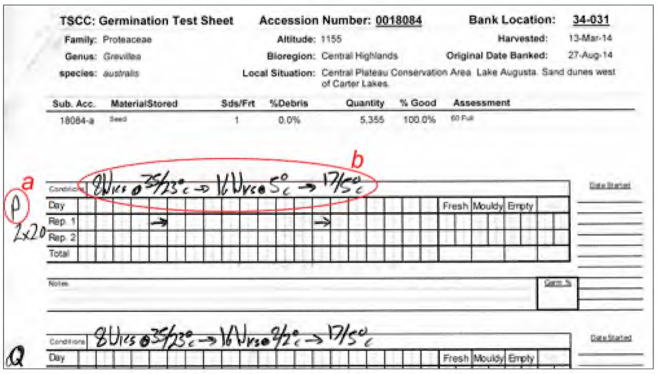


Figure 1. Germination test set-up equipment: petri dishes of agar, test sheets, sowing grid, seed boats and fine bamboo dibber. Photo: J. Wood



TSCC: Germination Test Sheet **Accession Number: 0018084** **Bank Location: 34-031**

Family: Proteaceae
Genus: Grevillea
species: australis
Altitude: 1155
Bioregion: Central Highlands
Local Situation: Central Plateau Conservation Area. Lake Augusta. Sand dunes west of Carter Lakes.
Harvested: 13-Mar-14
Original Date Banked: 27-Aug-14

Sub. Acc.	MaterialStored	Sds/Frt	%Debris	Quantity	% Good	Assessment
18084-a	Seed	1	0.0%	5,355	100.0%	60 Full

P
2x20
Conditions 8Wks @ 35/23°C → 16Wks @ 5°C → 17/5°C
Day | Fresh | Mouldy | Empty
Rep. 1
Rep. 2
Total
Date Started
Notes
Germ %

Q
Conditions 8Wks @ 35/23°C → 16Wks @ 9/2°C → 17/5°C
Day | Fresh | Mouldy | Empty
Date Started

Figure 2. Typical TSCC test sheet: a) test plate code, b) test treatments.

Volunteer involvement in the programme began slowly. The nature of germination testing requires a very regular and consistent volunteer involvement. Scoring is typically carried out weekly and therefore is a major commitment in time, when the duration of testing is considered. Germination tests at the TSCC can take as little as five weeks but generally take about 20 weeks and in certain cases can take over two years. These time lengths are a consequence of dormancy types and level expressed by wild seed. Non-dormant, conditionally dormant and physically dormant seed can generally be germinated very quickly given appropriate conditions. Other dormancy types can impose a series of blocks that need to be overcome successively, leading to these longer durations. Partly due to this aspect, volunteer recruitment has been done slowly and applicants are specifically warned, prior to induction, about the level of commitment required. A fair degree of experience is required with germination testing to become fully competent. As such I sit in with new volunteers when they first start or get them to work alongside long serving volunteers for a few sessions and I then monitor them as they get started. Wild seed bank germination testing is particularly challenging as we typically test a vast range of plant families producing seeds with very different internal morphologies and successfully germinating in a variety of ways. As there is no single source for this information, volunteers are reliant on your expertise and resources to guide them through this work.

To aid with orientating around cut-testing we have a copy of A.C.Martin (1946). Although this article has little coverage of major Australian families, the article is still useful in getting a measure of internal morphology variation. It's highly unlikely that you will find volunteers with a wide knowledge of seed and seedling morphology. Therefore, I encourage my volunteers to come to me if they are not sure about anything, have questions about finishing/transfer of tests or notice anything odd on the plates. What this means in practice is that on volunteer days I can expect to be called on, between once an hour to every ten minutes on particularly intense days.

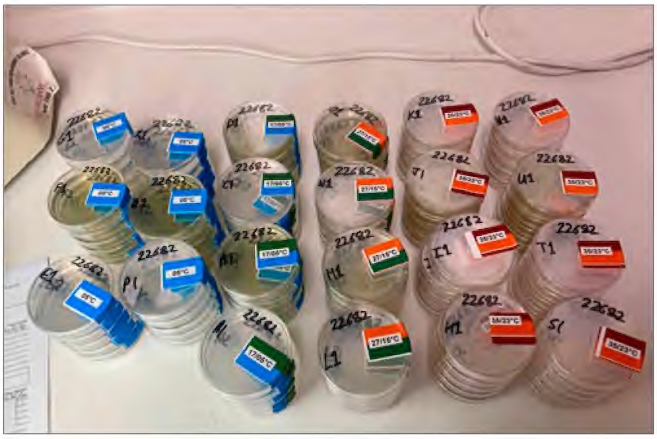
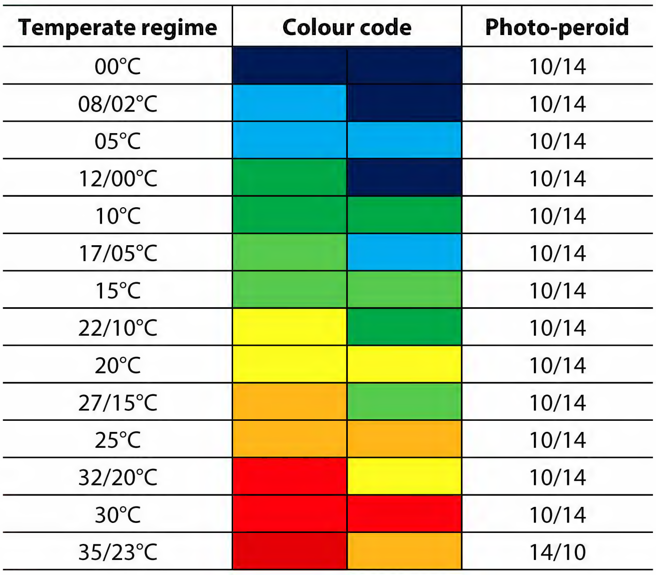


Figure 3. Sown and labelled 6 cm Petri dishes. Photo: J. Wood

It's not unfair to describe germination scoring as long periods of boredom punctuated with brief moments of excitement and this is explained in the process of volunteer introduction. It should also be appreciated that volunteer programs often have a group participation element that facilitates an important social engagement aspect to most activities. Our germination program doesn't really lend itself to that (doesn't necessarily exclude it) but it's important to explicitly talk about this aspect as well to properly inform expectations. Many of the failings in testing are due to momentary lapses in concentration (*e.g.,* miscounting of seedlings, placing plates in the wrong incubator, missing a transfer date) so it can be argued that a reduction in distractions is preferable. However, it's my observation that errors seem more likely to occur when volunteers have stressors outside of the volunteer activity. As such it's my recommendation that volunteers are supported to manage their workload to what they deem to be reasonable and not to take on too much. Additionally I try to separate our testing collections into two sets, one with collections that can be reasonably expected to germinate relatively quickly (<20 weeks) and the second with collections that will likely require lengthy, complex move-along trials (1-2+ years). I advise volunteers to take a mix of both, so they generally have some germination activity taking place and aren't spending months looking at petri dishes of seeds.

Table 1. Bicolour coding for incubator regimes at the TSCC.



Temperate regime	Colour code		Photo-peroid
00°C	🟦	🟦	10/14
08/02°C	🟦	🟦	10/14
05°C	🟦	🟦	10/14
12/00°C	🟩	🟦	10/14
10°C	🟩	🟩	10/14
17/05°C	🟩	🟦	10/14
15°C	🟩	🟩	10/14
22/10°C	🟨	🟩	10/14
20°C	🟨	🟨	10/14
27/15°C	🟧	🟩	10/14
25°C	🟧	🟧	10/14
32/20°C	🟥	🟨	10/14
30°C	🟥	🟥	10/14
35/23°C	🟥	🟧	14/10

Prior to 2019 test plates were labelled with accession number, date started, test code letter/s (Figure 1), replicate number (when applicable) and test conditions. Since early 2019 the TSCC has moved to a bicolour coding system for the incubator regimes (Figure 3 and Table 1), with colour coded printed labels (J8651) attached to plates, to replace writing the test temperature onto the plate. This system was adopted to help volunteers quickly spot plates going into the wrong incubator. Labels are attached so that part of the label runs out onto the side of the lid, so the bicolour code is visible for all plates in a stack. For move-along experiments the next regime label is placed on top of the previous label on the day of transfer. The system has been universally approved by the volunteers who like the extra safeguard in catching errors. So far, the system seems to be going well but we have had the occasional forgetting to update the label. Currently I'm attributing this to adjusting to a new testing practice (it's still too early to be sure) but ultimately no system can be foolproof.

Figure 4. Seedbank volunteers at the TSCC. Photo: J. Wood

I would gauge the TSCC volunteer germination group as a successful volunteer program. Although I have had about a fifth of applicants leave after 6 months the bulk of volunteers have been with the seedbank between 5–10 years. The TSCC volunteers are very self-motivated and find their work fascinating and rewarding. I don't shy away from sharing my frustration or excitement about test results and it's great to see that reflected by volunteers, particularly when they finally get some germination activity in a challenging collection. Although the primary goal of wild seedbanks is the *ex-situ* conservation of seed-bearing plants, the germination testing we conduct is equally as important. Testing is key to the functioning of a seedbank (why store seeds if you can't turn them back into plants?) however identifying techniques to germinate wild species has implications for the broader plant conservation community. As such the RTBG began sharing its germination data with the public since 2008 by placing it online. If you would like to see what we do you can find the TSCC Germination Database on the RTBG website (link below).

References

Martin, A. C. (1946). The comparative internal morphology of seeds. *The American Midland Naturalist*, 36(3), 513-660.

Resources

TSCC Germination Database
https://gardens.rtbg.tas.gov.au/conservation/tsccgerminationdatabase/

Seedbank Origami: envelopes, trays and boats
https://rtbg.tas.gov.au/wp-content/uploads/2020/07/RTBG_SeedBank_Origami.pdf

Ex situ management including seed orchard establishment for Native Guava (*Rhodomyrtus psidioides*) affected by Myrtle Rust

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In 2010, the plant pathogen *Austropuccinia psidii*, commonly referred to as Myrtle Rust, was detected in Australia for the first time on the NSW Central Coast. Over the subsequent decade Myrtle Rust's impact on many native Myrtaceae species has been significant, particularly for *Rhodomyrtus psidioides* (G.Don) Benth. or the Native Guava. Once common from Broken Bay on the NSW coast to south east Queensland and up to 120 km inland, in February 2019 the species was listed as Critically Endangered in NSW. *Rhodomyrtus psidioides* is severely threatened by Myrtle Rust over its entire range and characterised as 'extremely susceptible' to infection (Pegg *et al.* 2014; NSW Scientific Committee 2017). All plant parts have been documented as being affected including leaves, stems, flowers and fruits (Pegg *et al.* 2014; Carnegie *et al.* 2016; NSW Scientific Committee 2017). Damage to new foliage and subsequent failure to replace older leaves progressively weakens the plant, ultimately causing death. How long this process takes remains unclear. *Rhodomyrtus psidioides* readily suckers, however new growth is often rapidly overwhelmed by Myrtle Rust. Flowers and fruits are similarly affected and seldom manage to produce any viable seed, therefore *R. psidioides* struggles to reproduce either asexually or sexually in the wild and has suffered serious decline as a result.

Collecting seed or cuttings of *R. psidioides*, along with other Myrtle Rust susceptible species, was flagged as a high priority by Australian Plantbank collectors after the disease emerged in 2010. In the wild, plants were often covered in Myrtle Rust or had deteriorated to the point where taking cutting material was no longer feasible. Seed was often not viable, not filled or in such small numbers that it was impossible to determine seed storage behaviour. As a result, early seed collections were treated as orthodox and frozen at -18°C.

Conventional horticultural wisdom often prescribes ideals: plant material in good condition, pest and disease free, collected at a specific time of year, all supported by known data. The reality of working with many threatened species is that material may be limited and of poor quality, access to plants restricted due to rarity, location or other external factors, information on propagation and cultivation non-existent, and resources limited.

Potted plants of *Rhodomyrtus psidioides* developed flowers and fruit at a young age. Photo: Veronica Viler

Despite the best efforts of staff, by 2015 only 12 seeds were held in the Australian PlantBank, and four whole-plant genotypes in the nursery of the Australian Botanic Garden, Mount Annan (ABGMA). With so little material available, the ability to achieve any meaningful conservation outcomes appeared doubtful.

Later that year a program commenced to preserve the small nursery collection and develop propagation techniques for the species. In the first two years of growth, cutting grown plants became fertile and developed fruit. The resulting seed appeared viable and the idea for a seed production area was conceived.

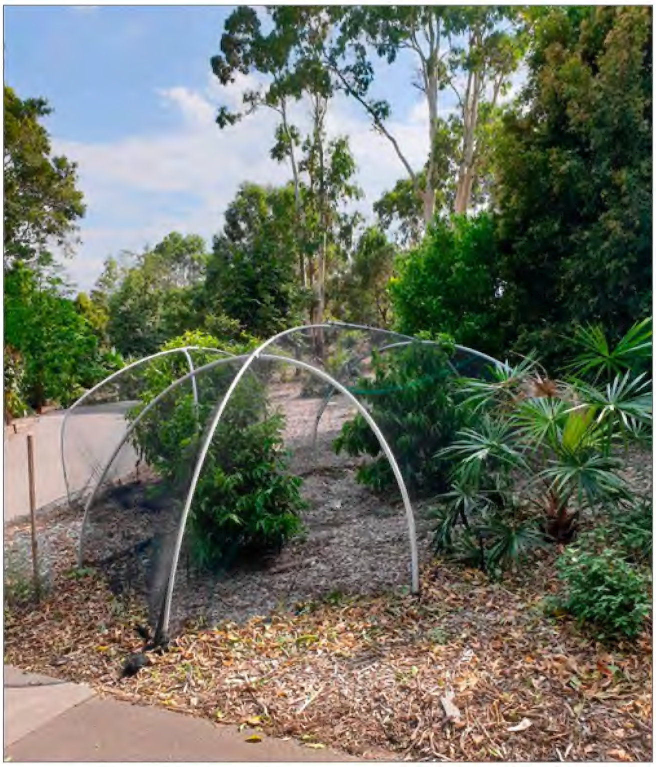
Managing Myrtle Rust-susceptible collections is especially challenging with a huge number of species and subspecies known to be affected. To date (2020), *A. psidii* has proved capable of infecting 382 native Australian plant species or subspecies (17% of the 2,253 known native Myrtaceae) (pers. comm. R.O.Makinson, July 2020). This meant the potential for outbreaks within the nursery and garden environment was considerable and therefore understanding the disease and current management strategies was essential. The safe use of chemicals permitted for treating Myrtle Rust requires attention to the surrounding environment and a high level of PPE (personal protective equipment).

Local weather conditions, micro-climates and seasonality all play a role in the behaviour of the disease. The lifecycle (sporulation, infection, to re-sporulation) of *A. psidii* can extend from the usual 2 weeks to 5-6 weeks under cooler conditions (Makinson 2018a, p41; Carnegie and Lidbetter 2012) and the pathogen's latent period (active but asymptomatic infection) can extend to overwintering in some hosts and conditions (Beresford *et al.* 2020). Quarantine and treatment of incoming plant material, diligent monitoring, appropriate cultural methods and sound hygiene practices are all vital to maintaining healthy potted and in-ground collections.

In February 2018, a planting site suitable for seed production was selected in consultation with the ABGMA horticultural staff. A strategy was agreed upon and three genotypes planted. Collections grown for research purposes necessitate more intensive management than those grown purely for ornamental display. Living collections can also provide an opportunity to educate the public and demonstrate the strong links between science and horticulture in conservation.

To optimise seed production and allow for Myrtle Rust control, plants were pruned and kept below two meters high. Watering was restricted to soil soaking to avoid moisture settling on foliage, a key requirement for Myrtle Rust spore germination (Makinson 2018a, p42).

Plants were left to pollinate naturally as the pollination system is open with multiple insect vectors (Williams 2018) and plants were monitored closely by staff. While waiting for the fruit to mature, the unripe crop sustained a large and unexpected loss to predation by birds.



***Rhodomyrtus psidioides* under netting at the Australian Botanic Garden, Mount Annan, to prevent predation by birds. Photo: Veronica Viler**

In April 2019, two maternal seed collections were processed yielding a modest 366 seeds. Seed storage testing for the species was possible for the first time. Germination of fresh viable seed was ≥ 87% and the seed was found to be desiccation tolerant but freezing sensitive, suitable for storage at 4°C rather than -18°C (Sommerville *et al.* 2019).

Germination testing produced several hundred seedlings, some of which were initiated into tissue culture for cryopreservation research, others given to partner botanic gardens as part of a broader conservation strategy for the species and the rest discarded. While it can be difficult to let go of surplus material, especially when it has been challenging to produce, prudent curation of research collections ensures time and resources are not wasted and duplication/distribution of material is a sound risk management strategy.

The following season, developing fruit on all three plants were netted to prevent further predation. Interestingly one individual that had not fruited well previously was the best performer, suggesting mast seeding. In all, three maternal collections were made in 2020, totalling 7,945 seeds. *"Editor's note: Mast seeding is where there is great variation in seeding among years, with many seeds being produced in some years and none (or very few) produced in others".*

The challenge for those working with threatened species is to find innovative ways to maximise outcomes with the material and resources available.

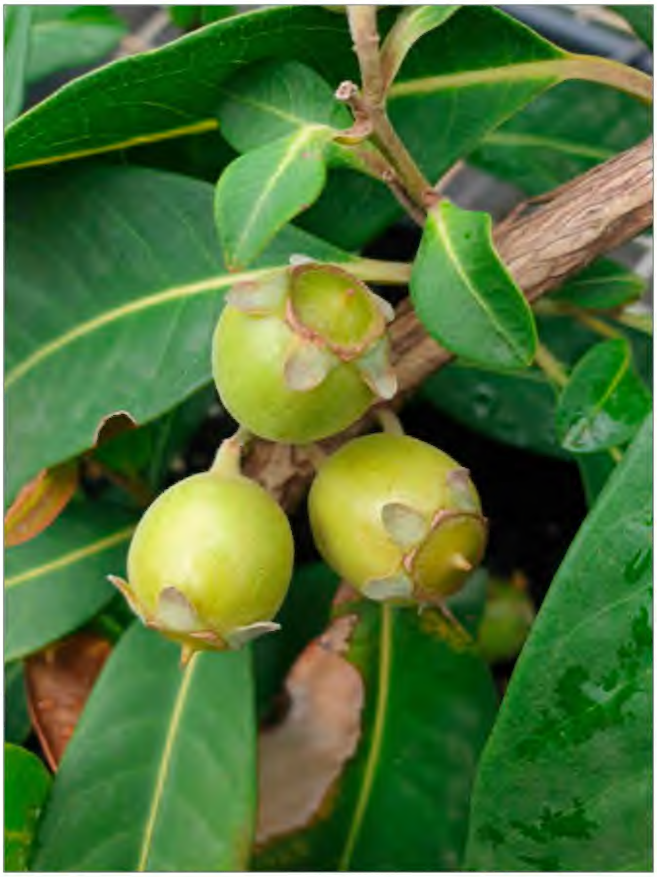
Vegetative propagation of *R. psidioides* has proven to be relatively simple via stem cuttings and sucker excavation where reasonable material exists, however at the time of writing, wild seed remains elusive and the future of *Rhodomyrtus psidioides* in the wild uncertain.

The actions described correspond to identified priority actions in the *Draft Action Plan* (DAP) for Myrtle Rust in Australia (Makinson 2018b). The relevant Actions are:

4.1.1, Secure future options for species in current or projected decline through germplasm capture; and

4.1.2, Seed storage, enablement research and determination of alternative germplasm storage options.

The establishment of reliable seed-production systems and the accumulation of seed in turn enable other DAP actions around screening for rust-resistance traits and eventual selection or breeding of more resistant genotypes.



***Rhodomyrtus psidioides* fruits. Photo: Veronica Viler**

***Rhodomyrtus psidioides* seedlings from cultivated plants in the nursery at the Australian Botanic Garden, Mount Annan. Photo: Veronica Viler**

Acknowledgements

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References

Beresford, R.M., Shuey, L.S. and Pegg, G.S. (2020). Symptom development and latent period of *Austropuccinia psidii* (Myrtle Rust) in relation to host species, temperature, and ontogenic resistance. *Plant Pathology* 69: 484-494.

Carnegie, A.J., Kathuria, A., Pegg, G.S., Entwistle, P., Nagel, M. and Giblin, F.R. (2016). Impact of the invasive rust *Puccinia psidii* (Myrtle Rust) on native Myrtaceae in natural ecosystems in Australia. *Biological Invasions* 18: 127-144.

Carnegie, A.J. and Lidbetter, J.R. (2012). Rapidly expanding host range for *Puccinia psidii* sensu lato in Australia. *Australasian Plant Pathology* 41: 1329

Makinson, R.O. (2018a). *Myrtle Rust reviewed: the impacts of the invasive pathogen* Austropuccinia psidii *on the Australian environment.* Plant Biosecurity Cooperative Research Centre, Canberra.

Makinson, R.O. (2018b). *Myrtle Rust in Australia – a draft Action Plan.* Plant Biosecurity Cooperative Research Centre, Canberra. Available at: https://www.anpc.asn.au/myrtle-rust/

NSW Scientific Committee (2017). *NSW Scientific Committee Preliminary determination* Rhodomyrtus psidioides. Available at: https://www.environment.nsw.gov.au/resources/threatenedspecies/determinations/PDRhodpsidCR.pdf

Pegg, G.S., Giblin, F.R., McTaggart, A.R., Guymer, G.P., Taylor, H., Ireland, K.B., Shivas, R.G. and Perry, S. (2014). *Puccinia psidii* in Queensland, Australia: disease symptoms, distribution and impact. *Plant Pathology* 63: 1005-1021.

Sommerville, K.D., Cuneo, P., Errington, G., Makinson, R.O., Pederson, S., Phillips, G., Rollason, A., Viler, V. and Offord, C.A. (2019). Conservation in the wake of Myrtle Rust – a case study on two critically endangered Australian rainforest plants. *Pacific Conservation Biology* https://doi.org/10.1071/PC19026

Williams, G. (2018). Insects associated with flowering of *Rhodomyrtus psidioides* (Myrtaceae): Is this a Myrtle Rust (*Austropuccinia psidii*)-induced plant-pollinator interaction extinction event? *Cunninghamia* 18: 23-27.

Strings Attached: Managing *ex situ* plants highly susceptible to pathogens

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Cultivating plants in *ex situ* collections is an important method to support plant conservation. Several recent *ex situ* projects at Auckland Botanic Gardens (ABG) have highlighted some complexities of this approach when a plant is threatened by an invasive pathogen. For managers of wild sites, where threatened plants are declining due to pathogens, removing plants and/or germplasm to the safety of an *ex situ* provider such as a nursery or a botanic garden is a well-established response in threatened plant recovery management. For a recipient nursery, the opportunity to participate in threatened plant recovery is a tangible way to demonstrate a clear role in plant conservation and a rewarding way for staff to contribute to a recovery project. However if the subject plant is host to a devastating environmental pathogen which may infect other crops on site, put collections at risk or adversely affect other projects undertaken on site (including those with other stakeholders), thought must be given to how to manage these issues. When Myrtle Rust (*Austropuccinia psidii*) surfaced as a threat to Myrtaceae, many practices at our nursery were reviewed.

Nursery Biosecurity

Nursery biosecurity is an increasing focus for nurseries and botanic gardens worldwide (Hayden 2020) to prevent the proliferation and movement of invasive pathogens which have the potential to adversely affect wild ecosystems and increase the risk of extinction of highly susceptible plant species. Nurseries provide pathogens with opportunities to infect a range of susceptible hosts or habitats (such as pots), in one location. Biosecurity accreditation schemes in both New Zealand (NZPPI) and Australia (Greenlife Industry Australia) assist nurseries to mitigate the risk through a systems approach to minimise the arrival and proliferation of pests in the nursery setting and mitigate the risk of introducing pathogens into new wild sites through infested nursery raised stock in revegetation programmes (Frankel *et al.* 2020). At its core, nursery biosecurity is based on the principle of preventing the arrival and establishment of a pathogen as the most effective way to maintain nursery hygiene.

Growing susceptible species

Accepting material into an *ex situ* facility which is highly susceptible, for example to Myrtle Rust, from an area where Myrtle Rust is established, runs somewhat counter to biosecurity principles. Acquiring species susceptible to a specific invasive pathogen must be managed on a case by case basis depending on the nature of the pathogen, including its life cycle and mode of spread. Not all options for germplasm collection may be equally risky in terms of pathogen spread and this should be the key consideration before supplying material to an *ex situ* provider. For research purposes, including determining resistance, maintaining infected and uninfected plants is useful but should only be considered when this does not endanger other collections.

Relevant legislation must also be considered as, at least for a new incursion to a country or region, the pathogen may be subject to biosecurity laws which prevent movement of material (and may include all plants in a susceptible family, not just infected plants) and which may prescribe treatments (or require host destruction). Myrtle Rust, for example, remains an 'unwanted organism' under the New Zealand Biosecurity Act (1993) to prevent new strains arriving in New Zealand. As such, it is prohibited to knowingly move infested plants or spread Myrtle Rust to new locations. Discussions between *in situ* managers and *ex situ* providers should identify the best location for the *ex situ* collection, the management required to acquire and grow the species safely and produce an incursion response plan.

Choosing an *ex situ* provider

This is arguably the most important decision in the conservation management of an *ex situ* population for a highly susceptible plant. There are two primary considerations: the services required and the geographic range of the invasive pathogen. Not all *ex situ* providers have the same facilities and an *ex situ* provider should be chosen based on whether they can hold the material for the purpose required. Most can propagate material from cuttings or seed to produce plants for display, seed orchards or production for translocation to the wild. Not all *ex situ* providers have seed banks or the ability to hold tissue cultures (and often this may be the least risky method of *ex situ* cultivation of a highly susceptible plant).

For a highly susceptible species, seed orchards or plant production for restoration is ideally undertaken by a provider outside of the climatic range of the pathogen. In most cases, a range of *ex situ* providers will be required to conserve a highly susceptible species. Botanic Gardens Australia New Zealand (BGANZ) is a network of *ex situ* providers who can facilitate discussions on the best providers to suit the needs of *in situ* managers. A network can also be used to find suitable locations for duplicate collections, that are essential as insurance against losses.

There is a role for many providers to contribute to the conservation of a highly susceptible plant species, for example, regional botanic gardens may be suitable for seed orchards outside of the range of the pathogen. Advice from relevant biosecurity agencies should be sought before moving potentially infected material to a location outside of the current range of the pathogen.

Three years prior to the arrival of Myrtle Rust ABG identified *Lophomyrtus* as a target for wild seed collection based on the susceptibility of similar species in Australia (*Rhodamnia* and *Rhodomyrtus*). The project revealed poor seed set on local wild plants. We planted seed-raised individuals with the intention of forming seed orchards to maximise seed production. Since the arrival of Myrtle Rust, all plants have died and while only a few had confirmed infections of Myrtle Rust, we realise that because our Garden is in the range of Myrtle Rust, that without fungicide treatments we are not the best location for a seed orchard. *Lophomyrtus* species (*Lophomyrtus bullata* and *L. obcordata*) and their cultivars (including natural hybrids) have more confirmed infections of Myrtle Rust (Figure 1) in New Zealand than any other species (Black *et al.* 2019). This genus is also emerging as the most affected New Zealand native species in the wild and both species are regarded as threatened (Nationally Critical; de Lange *et al.* 2017). No resistance has been detected to Myrtle Rust in *Lophomyrtus bullata* (Smith *et al.* 2020).

When Myrtle Rust arrived in New Zealand, we duplicated a collection of the highly threatened *Metrosideros bartlettii* to botanic gardens outside the expected climatic envelope of the rust. Long term, if a plant is highly susceptible to a pathogen then this is its most realistic chance for survival, and potentially only chance without intensive ongoing management.

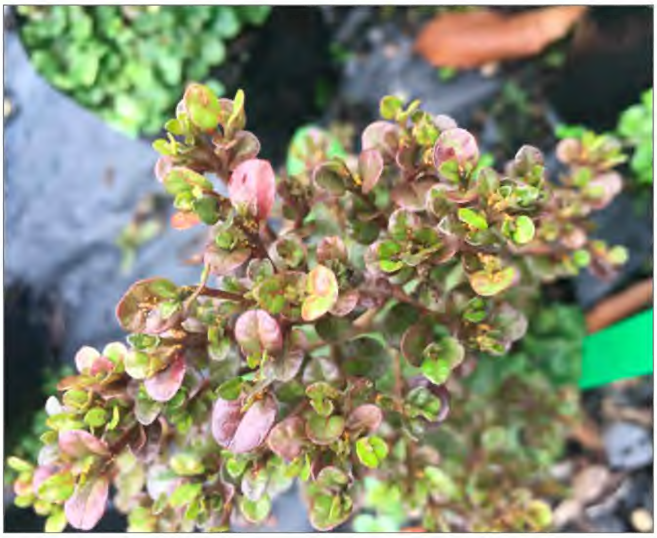

Figure 1. Myrtle Rust infection on *Lophomyrtus* 'Plum Duff'. Photo: Emma Bodley

Pathogen Management

An *ex situ* provider within the range of a pathogen may still be able to contribute to conserving a susceptible species. Each provider will have their own best practice for pathogen management, and this should be discussed to minimise the chance of moving a pathogen to an *ex situ* facility. At ABG, for example, no seeds which have fallen on the ground are collected for our revegetation programme to reduce the potential for soil containing the causal agent of Kauri Dieback (*Phytophthora agathidicida*) arriving.

Susceptible species may be managed by housing them separately to other crops. ABG hold more individuals of *Metrosideros bartlettii* (rāta Moehau) than any other *ex situ* location. This species is regarded as Nationally Critical (de Lange *et al.* 2017) with less than twenty plants known from the wild (Figure 2). We are custodians of this material held on behalf of local Māori communities to assist, eventually, with the return of species to the wild. Material was acquired before Myrtle Rust arrived in New Zealand and subsequent to the arrival of the rust, the rāta were placed in a separate greenhouse to provide a physical barrier to attempt to reduce inoculum reaching the plants. There is no overhead watering to reduce suitable conditions for Myrtle Rust, which prefers high humidity. The plants require hand-watering and a preventative fungicide programme operates in spring to late autumn applied at fortnightly intervals, and monthly in winter. It is important to observe plants regularly post treatment, as in some cases species will respond differently to types of fungicides. These may need to be tested to ensure no negative impact on the plant growth occurs with treatment regimes.

Treatment and control regimes can maintain the health of a crop, but this requires committing to an ongoing, potentially indefinite, programme. *Ex situ* providers must weigh up the costs to ongoing management including time to apply treatments, staff training to use chemicals and extra responsibilities such as surveying and monitoring. Surveying for incursions and monitoring plant health are critical to ensure a treatment regime is effective.

Ex situ providers in the range of a pathogen can be useful by providing material that is in high demand by researchers, which commercial nurseries may no longer provide. One of the early effects of the arrival of Myrtle Rust was the loss of *Lophomyrtus* species and cultivars from the trade. During the year-long eradication phase, any detection of Myrtle Rust in a nursery would result in loss of stock, restrictions on trade and reputational risk. *Ex situ* providers can fill this gap, if suitable treatments and controls can be put in place to ensure this does not affect other crops or projects.

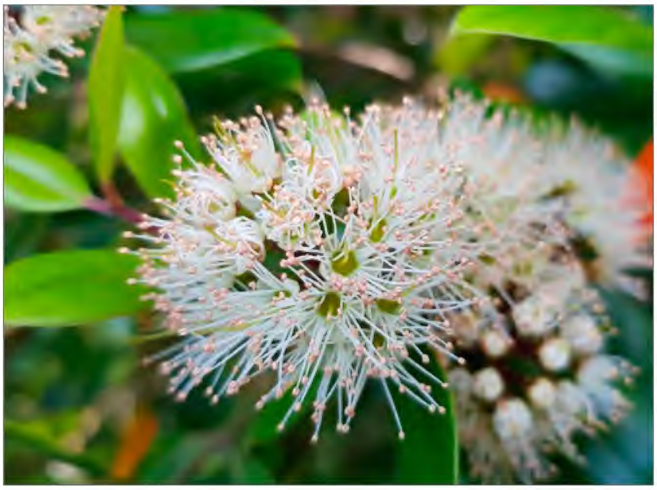

Figure 2. Flowers of rāta Moehua, *Metrosideros bartlettii*. Photo: Greg Meylan

The most difficult decisions about acquiring a highly susceptible plant will be those cases where so few wild sites remain after an incursion that any material brought into *ex situ* cultivation is infected. It is normal nursery practice that infested material is rejected or destroyed on arrival. Options for bringing highly susceptible material into cultivation must be discussed to identify the safest methods *e.g.,* collecting at a time when the pathogen may be dormant, cleaning the seed and treating material on arrival. Sommerville *et al.* (2020) outline an example of a treatment programme for producing 'clean plants' even after infection with Myrtle Rust. Pathologists and propagators must work together to establish the cleanest possible propagation strategy that ensures the plant is healthy and no other work is jeopardised.

Incursion Response Plan

For any *ex situ* provider acquiring a plant highly susceptible to an invasive pathogen, it is prudent to consider actions if an incursion occurs. An incursion plan is an agreed response if, or when, a pathogen arrives and infests the conservation collection. Ideally this plan is in place before or very soon after an *ex situ* program begins. All stakeholders must be consulted in its preparation, so there are no surprises or potential losses of valuable research or conservation material. Issue to address include deciding when to cull infected material. Material may still be treatable, depending on the pathogen, or the material may be useful for research. ABG acquired a collection of 13 cultivars of *Lophomyrtus* to test for resistance to Myrtle Rust and when they all became infected the plants were useful for a pathologist working on the rust. They are now planted in a research collection offsite (Beresford *et al.*, 2020).

An incursion plan is also likely required by nursery accreditation programmes and ensures systems have integrity. Plans also allay potential concerns of stakeholders involved in other projects at your facility. ABG grows 65,000 native plants each year for forest restoration (Figure 3). Three early successional species of Myrtaceae including *Metrosideros excelsa* (pōhutukawa), *Leptospermum scoparium* (mānuka) and *Kunzea robusta* (kānuka) form the bulk of species we grow for revegetation projects. For the site managers where these plants will eventually be taken, a plan provides reassurance that work on highly susceptible Myrtaceae will not infect their plants, or the wild sites where they will be translocated.

Summary

In the past three years, the incursion of Myrtle Rust has required Auckland Botanic Gardens to reflect on how we acquire plants which may be threatened, but which are also highly susceptible to an invasive pathogen that we do not want established in the nursery. The arrival of Myrtle Rust, a wind-borne pathogen, challenged our thinking about nursery hygiene because the rust had the potential to arrive despite our nursery biosecurity systems. We have deduced that our site may not be the best location for seed orchards of highly susceptible species (*e.g., Lophomyrtus* spp.), that this is an activity that would be better suited to a location outside of the range of Myrtle Rust. Others, such as *Metrosideros bartlettii*, are smaller collections held as insurance, and can be housed in a greenhouse separated from the main collections and treated with fungicide to prevent infection. We have established that if we get infections, we can re-home these plants to researchers. We advocate that managers of wild sites who require *ex situ* providers to support conserving plants highly susceptible to pathogens, that they discuss their requirements with a botanic garden to identify the best location for the *ex situ* collection, the treatments and controls required to manage it and a plan for when incursions occur.

References

Beresford, R., Stanley, R. and Bodley, E. (2020). *Field susceptibility of horticultural selections of* Lophomyrtus *species and hybrids to Myrtle Rust (*Austropuccinia psidii*).* Plant and Food Research, Auckland.

Black, A., Mark-Shadbolt, M., Garner, G., Green, J., Malcolm, T., Marsh, A., Ropata, H., Waipara, N. and Wood, W. (2019). How an Indigenous community responded to the incursion and spread of Myrtle Rust (*Austropuccinia psidii*) that threatens culturally significant plant species–a case study from New Zealand. *Pacific Conservation Biology* 25: 348-354.

de Lange, P.J., Rolfe, J.R., Champion, P.D., Courtney, S., Heenan, P.B., Barkla, J.W., Cameron, E.K., Norton, D.A. and Hitchmough, R. (2013). *Conservation status of New Zealand indigenous vascular plants* (p. 70). Publishing Team, Department of Conversation.

Frankel, S.J., Alexander, J., Benner, D., Hillman, J. and Shor, A. (2020). *Phytophthora* pathogens threaten rare habitats and conservation plantings. *Sibbaldia: the International Journal of Botanic Garden Horticulture* 18: 53-65.

Hayden, K. (2020). Botanic gardens and plant pathogens: a risk-based approach at the Royal Botanic Garden Edinburgh. *Sibbaldia: the International Journal of Botanic Garden Horticulture* 18: 127-139.

Smith, G.R., Ganley, B.J., Chagné, D., Nadarajan, J., Pathirana, R.N., Ryan, J., Arnst, E.A., Sutherland, R., Soewarto, J., Houliston, G. and Marsh, A.T. (2020). Resistance of New Zealand provenance *Leptospermum scoparium*, *Kunzea robusta*, *Kunzea linearis,* and *Metrosideros excelsa* to *Austropuccinia psidii*. *Plant Disease*, pp.PDIS-11.

Sommerville, K.D., Cuneo, P., Errington, G., Makinson, R.O., Pederson, S., Phillips, G., Rollason, A., Viler, V. and Offord, C.A. (2019). Conservation in the wake of Myrtle Rust–a case study on two critically endangered Australian rainforest plants. *Pacific Conservation Biology* https://doi.org/10.1071/PC19026

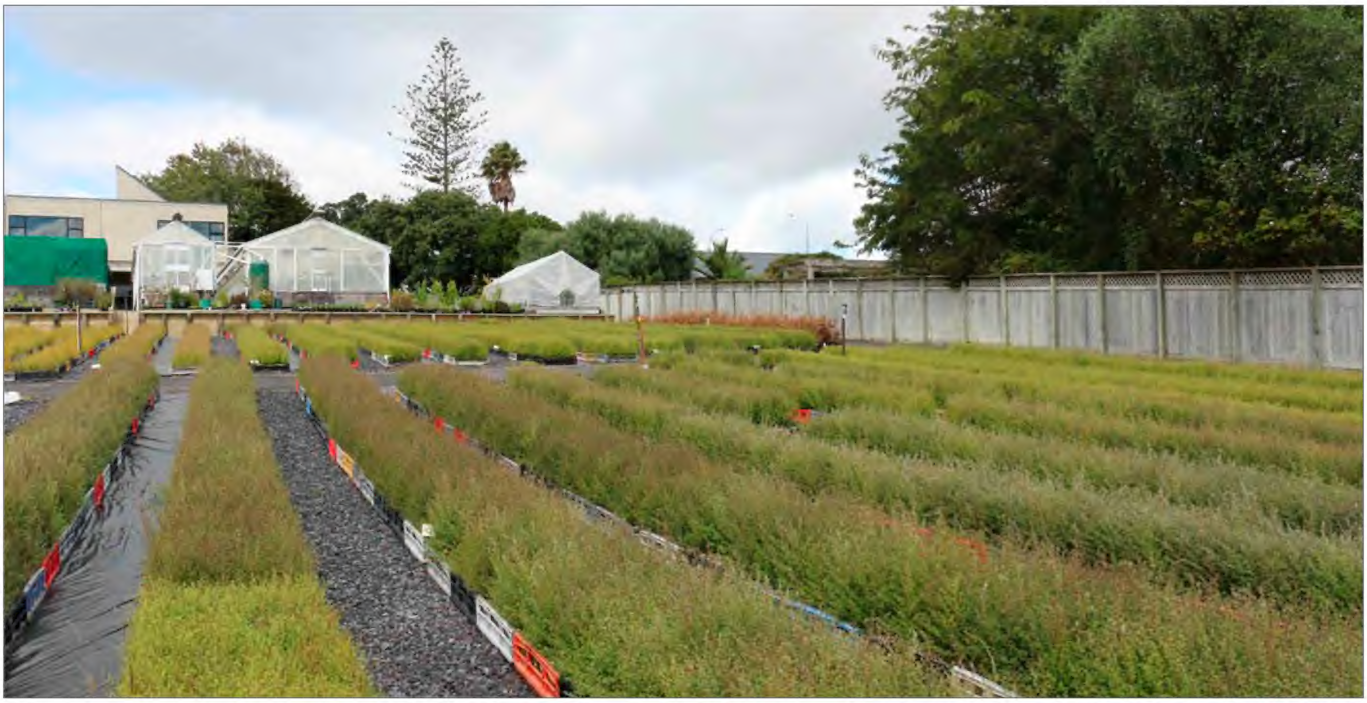

Figure 3. Rows of native plants for forest restoration. Photo: Bec Stanley

Using clonal genetic structures to inform and develop an *ex situ* conservation strategy for *Grevillea renwickiana*

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Grevillea renwickiana F.Muell. (Nerriga Grevillea) is a critically endangered prostrate rhizomatous, root-suckering shrub (Makinson 2002). It is endemic to New South Wales, confined to the Braidwood-Nerriga area where it grows on sandy soils in open dry sclerophyll forest. *In situ* flowering occurs during summer months but appears to be irregular and the flowers putatively sterile.

In 2011 members of the Australian National Botanic Gardens' (ANBG) Living Collections staff located a population of the Nerriga Grevillea on private property east of Nerriga. As there were no Australasian Virtual Herbarium records of the species in that area, we alerted the Threatened Species Officers of the then NSW Office for Environment and Heritage (OEH, now the Department of Planning, Industry and Environment (DPIE)), who informed us of relevant research on the species. Elizabeth James from Royal Botanic Gardens Victoria had undertaken genetic analyses of the species and identified eight genetic individuals that were generally restricted to single populations (James & McDougall 2014).

Identifying an opportunity to include the new population in ongoing genetic studies and recognising potential for developing a scientifically backed *ex situ* conservation plan for the species, we discussed a sampling strategy with Elizabeth James and Keith McDougall (DPIE). We modified our standard collection method of taking a herbarium specimen and cuttings from a single plant or area to match the methodology used by James and McDougall (2014), enabling comparisons to be made with previous work.

Samples were collected from three accessible locations over a total distance of 2.5 km, maintaining a minimum distance of 10 m between sampled plants. Two herbarium specimens were taken, one from either end of the collection transect. This resulted in 16 new collections (accessions), which were each given a unique field number, locality description and geocode. For each new collection, samples consisting of four or five leaves were placed into silica gel for genetic analysis and a small number of cuttings were collected and tracked using the same field collection number as the corresponding genetic sample. The cuttings struck well and multiple plants from the 16 collections were later grown and maintained as individual accessions in the ANBG Nursery.

Elizabeth James conducted a genetic analysis of the 16 samples taken from the newly located population and identified two genetic individuals; this is only the second time that more than one genotype has been recorded in a single population of the species. Based on these findings and other scientific advice, the ANBG condensed the 16 accessions into two separate accessions, retaining their genetic identity. This reduces the complexity of short-term management of the lineages and dramatically increases the feasibility of retaining the long-term scientific integrity of the *ex situ* collection.

One of the newly identified genomes of *Grevillea renwickiana* growing in the Australian National Botanic Gardens. Photo J. McAuliffe

Grevillea renwickiana **sterile flower from Corang B site. Photo E. James**

In designing an *ex situ* management plan for this species, its typical growth habit, characterised by its rhizomatous spread, must be considered. The plant's ability to sucker from rootstock and shed old stems, and to spread with new above-ground stems has the potential to complicate or undermine lineage tracking within any cultivated situation such as a botanic garden. Even without a total understanding of this capability we can design *ex situ* environments that aim to maintain separation of clones, by either physical separation or by using barriers to prevent crossover. We have observed slow growth of plants from an earlier collection cultivated in ANBG for 20 years. In one instance, the actively growing parts of a plant migrated a short distance over several years. We have learnt that once established, plants are likely to be long-lived. This informs collection management decisions such as how many individual plants of an accession are required to maintain clonal lineages over time and provides insights for the development of succession plans.

It is important that planting records facilitate long-term accession identification. The ANBG uses embossed aluminum plant tags to manage identification of planted stock. These are either attached to aluminum stakes or directly to the plants using plastic-coated tie wire. Plants are mapped and details recorded on a database integrated with the herbarium records. The data management system is designed to be able to cope with complications that arise if one or more recording systems fail, typically via the loss of the plant label. By creating and retaining contingency records, the ANBG can later identify unlabelled accessions by using mapping records or other documentation such as section management plans. These systems are only capable of maintaining accurate long-term data if the lineage management plans are sound.

In the case of *Grevillea renwickiana*, the ANBG has deliberately planted a single clonal lineage in a section and separated the plants from other clonal lineages with a physical barrier such as a road. By planting only one clonal lineage per section, the possibility of confusing lineages can be decreased significantly. When appropriate records are maintained, long-term management of clonal lineages is achievable at a relatively low cost and resource effort if the cultivation requirements of a species are straightforward.

However, there are a number of practical factors to consider when managing multiple separate lineages of a species in a botanic garden's living collection. There are always possibilities for human error in data management. Gardens staff need to be well-versed in data management to facilitate long term retention of plant collections of high scientific value. Operating in a public space can add additional challenges to maintaining the scientific integrity of living collections. Botanic gardens also face resource restrictions that can undermine scientific and conservation objectives over time. It is therefore important that botanical institutions with ambitions to contribute to *ex situ* conservation be pragmatic in their overall approach to collection management. One of the key objectives of an *ex situ* collection is to facilitate *in situ* conservation options.

Good conservation outcomes can be achieved through working collaboratively with the scientific and natural resource management communities. This is especially the case with sterile species, such as *Grevillea renwickiana*, where seed banking is not an option and knowledge of genetic structure can have a large impact on collection management decisions and improve the quality of the *ex situ* conservation collections.

A great starting point for securing the future conservation of *Grevillea renwickiana* is ensuring that a botanic garden holds a comprehensive *ex situ* collection. At present, only the two recently collected clonal lineage accessions of *Grevillea renwickiana* are held by the ANBG. Obtaining the eight additional genomes identified in James & McDougall's study for the ANBG collection would provide a comprehensive *ex situ* conservation holding of this threatened species for Australia. In theory, the ANBG has the capacity to hold and maintain all these lineages.

It is important to recognise that the security of both *ex situ* collections and conservation of wild populations of the species will be best achieved if the known diversity of *Grevillea renwickiana* is held in more than one botanical institution. The NSW South-East Bioregion Working Group is a conservation-focused collaboration between the ANBG, the Australian Botanic Garden Mount Annan, Wollongong Botanic Gardens, Booderee Botanic Gardens, Eurobodalla Regional Botanic Gardens and Illawarra Grevillea Park. This group, with support from the NSW DPIE, relevant land authorities, private property owners, communities and other conservation/landcare-oriented groups can develop and enact a feasible *ex situ* security plan for the Nerriga Grevillea. If this can be achieved, developing *ex situ* conservation plans for similar sterile species could be modelled from this example.

Summary

Early and open communication between government agencies and conservation practitioners, in this instance, was a key factor that influenced the ANBG's approach. By considering and contributing to the latest genetic analysis of *Grevillea renwickiana*, the ANBG has been able to apply the most appropriate collection management practices and horticultural knowledge to its *ex situ* holdings of the species. The Gardens now holds 20% of the known diversity of the species. This results in an efficient and effective use of resources. Future investment from the scientific community, government agencies and collaboration between botanic gardens could achieve viable long-term *ex situ* security of the species that may facilitate increased *in situ* management options and draw interest from community groups, promoting conservation awareness in regional communities.

Acknowledgements

In the development of this case study I would like to thank the private property owners for granting access and their continued interest in helping to protect this species. Heather Sweet (ANBG), Anna Monro (ANBG), Elizabeth James (RBG Vic), Keith McDougall (DPIE NSW), and Amelia Martyn Yenson for publications (BGCP NSW and ANPC) are all acknowledged for their significant contributions, including comments on draft versions of this text.

References

James, E. A. and McDougall K. L. (2014). Spatial genetic structure reflects extensive clonality, low genotypic diversity and habit fragmentation in *Grevillea renwickiana* (Proteaceae), a rare, sterile shrub from south-eastern Australia. *Annals of Botany* 114: 413-423.

Makinson R. O. in Harden, G. J. (ed.) (2002). *Flora of New South Wales* (revised edition) 2: 46 (In *Grevillea* treatment pp. 32-66)

News from the Australian Seed Bank Partnership

Note from ASBP: The news article following from the ASBP highlights the approach used for seed collection by Kings Park and Botanic Garden to secure germplasm of Western Australia's diverse flora for conservation programs, research and display in the State's Botanic Garden. Using GIS systems to locate collecting targets and digital record-keeping technology in the field improves success and efficiency in a collecting program operating over a vast area.

Finding a Needle in a Biodiversity Haystack

LUKE SWEEDMAN* AND PATRICK COURTNEY

Kings Park and Botanic Garden.

*Corresponding author: luke.sweedman@dbca.wa.gov.au

Biodiversity Hotspot

Western Australia is Australia's largest state, and the second largest country sub-division in the world. Its total land area exceeds 2.5 million square kilometres, which is 11 times the size of the UK and seven times larger than Germany. The State is also sparsely populated, with 92% of its 2.6 million inhabitants living in the south-west corner, mostly in the vicinity of the capital, Perth.

Western Australia is a floristic wonderland with an amazing biodiversity. The South-west region of the State has been identified as a global biodiversity hotspot, and eight of Australia's 15 National Biodiversity hotspots are in Western Australia. To date, around 13,000 plant taxa have been identified, and it is estimated that to complete a census of the vascular plant species alone will take at least another two decades.

Western Australia contains diverse ecosystems, including subtropical and tropical forests and savannah woodlands in the north; vast deserts in the central arid region; and a Mediterranean-type climate in the south where heathlands, shrublands and temperate woodlands with some of the tallest hardwood trees in the world are found. The ancient soils of Western Australia support a stunning range of flora often typified by complex speciation and high endemism.

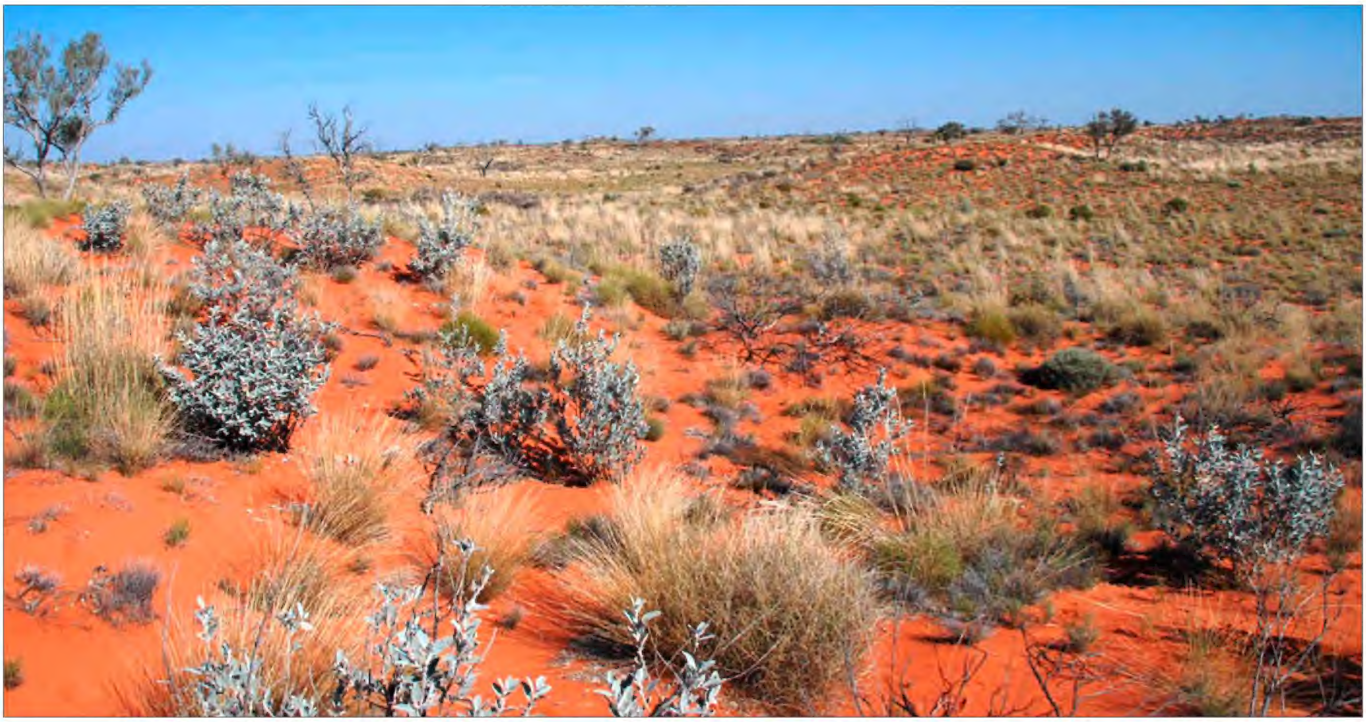


Figure 1. The grey foliaged *Thinicola incana* – a target for collection in the Little Sandy Desert. Photo: L. Sweedman

Seed Collecting Program

The Western Australian Botanic Garden in Kings Park, Perth has maintained a focus on the conservation, research, display and interpretation of the Western Australian flora since its establishment over 55 years ago. Leading up to its opening in 1965, a field collection program was established with a dedicated collector to bring germplasm from throughout the State to the Botanic Garden to develop the living collections. As much of the flora had not been previously cultivated, a key function of the Botanic Garden was plant research, along with collection, storage, cultivation and display of this diverse flora.

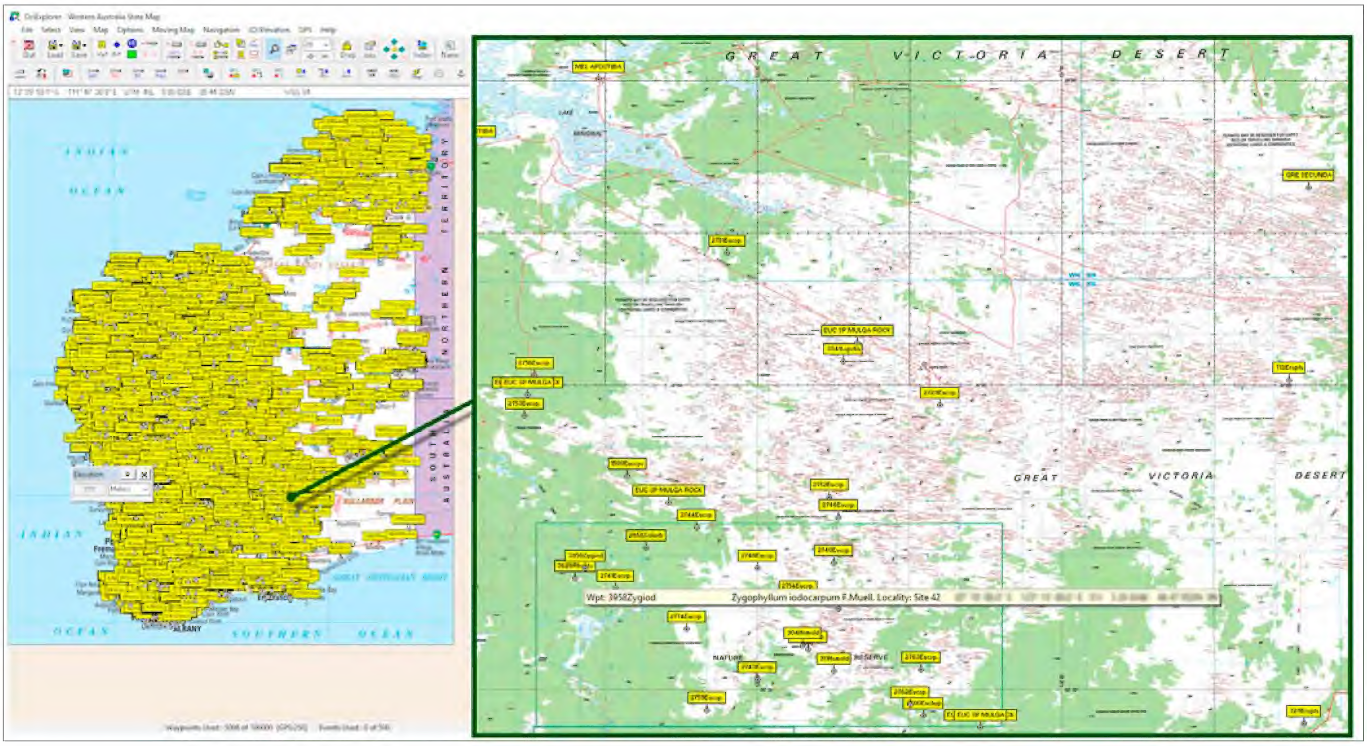
Collectors sometimes explore extremely remote locations that present a range of unique logistical and resourcing challenges. Project funding from institutions such as the Millennium Seedbank has allowed Kings Park to access and collect within these remote environments more extensively than would otherwise have been possible, supporting key conservation outcomes for future generations.

The collecting process involves a pre-planning phase in which target species are identified for collection and the travel route is planned. Data is recorded as collections are made including a herbarium specimen to support the collection and verification of species identification. While most collection data was recorded by hand in field books in the past, much has changed to refine the early field collection program, particularly through more recent advances in technology.

Digital Technology

Given the extent of Western Australia and its species richness, collection programs require a strategic and systematic approach to meet program goals and source target species. To achieve this, a range of data sources and information systems are used, including:

- Species distribution data.
- Climate and rainfall data.
- Fire history data.
- GIS systems.
- Oziexplorer – real-time GPS mapping systems.
- BGBASE – biological collections management database software.



Wpt: 3958Zygiod Zygophyllum iodocarpum F.Muell. Locality: Site 42

Figure 2. Screenshot from Oziexplorer GPS mapping software showing a plot of Kings Park's 2015/16 target species locations (left) and expanded view showing a mapped target location (right).

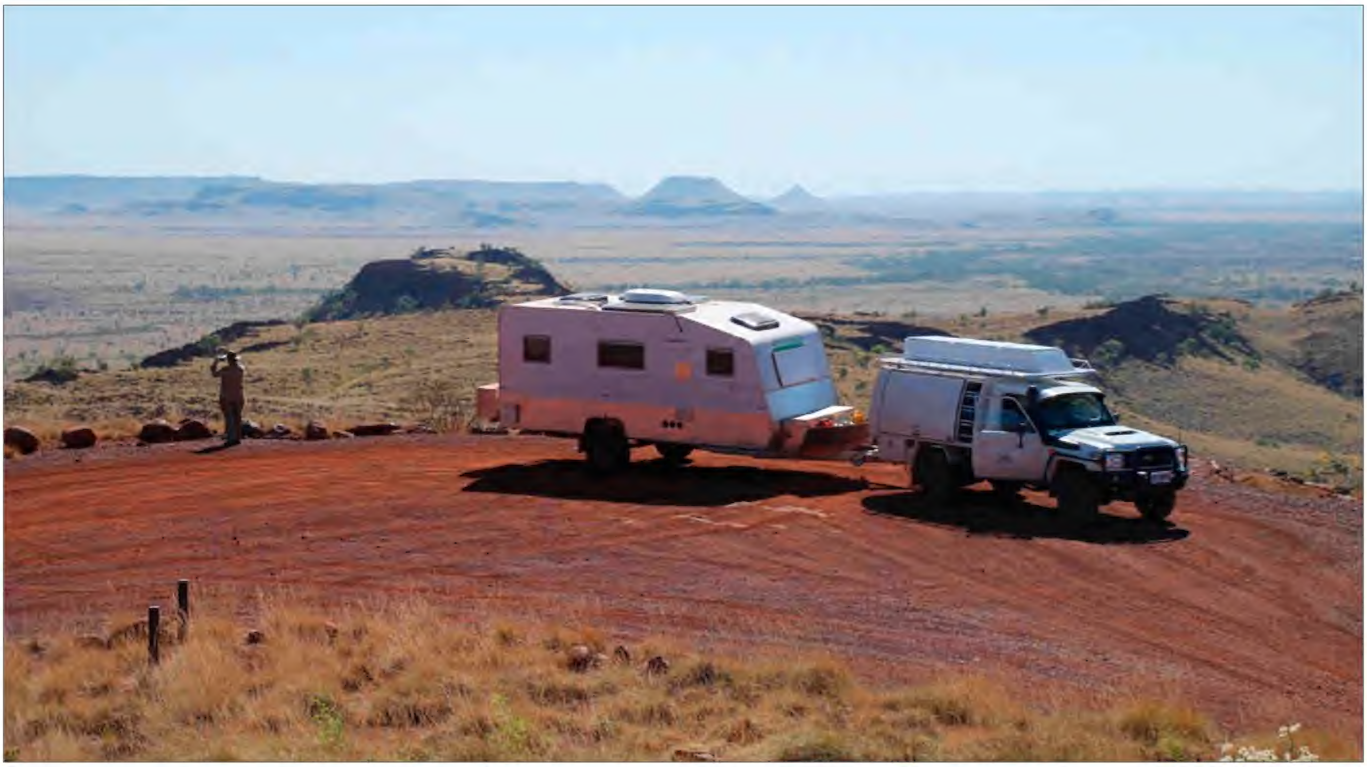


Figure 3. Kings Park's mobile seed collection unit approaching the remote Mt Pyramid Station, Northwest Pilbara. Photo. L. Sweedman

Analysis of climate, soils, fire history and other datasets are overlayed with known species distributions and associated floristic characteristics to allow Curators to develop targeted collection programs within particular phytogeographical regions.

To maximise productivity in the field – especially in relation to remote locations – Kings Park has developed specialised collection vehicles, equipment and electronic systems to improve efficiencies. Real-time mapping applications such as *Oziexplorer* can plot plant populations and enable collectors to navigate to any target species or area, while providing key background information within base maps.

Data from collection records can be entered directly into the biological specimens database (BGBASE) in the field, effectively removing the need for paper-based record systems. These digital field records can then be transferred electronically to the main system on return to Kings Park.

Field trips vary from several days through to two months, with up to 70 days spent in the field each collection season. Kings Park field vehicles provide an all-terrain, off-road ability and incorporate an off-road caravan as a remote base. These vehicles enable Kings Park to travel long distances safely and with self-sufficiency. The vehicle systems incorporate solar power, refrigeration for perishable food and propagule material, water and long-range fuel tanks, along with specialised seed collection and storage equipment.

The development of these collection systems has been invaluable, saving time and improving the accuracy when locating target species and recording collection data. The system, developed over many years to accommodate the needs of collecting within a highly diverse and expansive State, has proven predictable, robust and highly efficient.

ANPC Workshop and Publications report

Revisiting the National Seed Survey

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Due to COVID-19 restrictions the ANPC has been unable to hold in-person workshops. We are busy tackling this challenge and hope to release more details soon. In the meantime, we are revisiting an important topic in plant conservation – the native seed sector.

Where will the seeds come from?

The native seed sector faces many challenges in delivering seeds, which are the foundational element for ecological restoration projects. To better understand the ability of the sector to meet current and future seed demands the ANPC commissioned the Australian Native Seed Survey in 2016-2017.

Background

The Australian native seed sector is composed of a range of individuals, businesses and organisations and an interaction of factors present challenges to its operation. These include native vegetation loss and fragmentation, low or intermittent restoration funding, and climate change impacts.

The ANPC with support from the Rural Industries Research and Development Corporation (now Agrifutures Australia) conducted a national survey to better understand the sector's structure and practices, and explore the issues affecting its activities and capacity to meet seed demand.

Results

A total of 146 survey respondents identified themselves within the categories of seed collectors, Seed Production Area (SPA) growers, seed purchasers, and other users such as researchers. According to the category chosen, respondents were asked between 18-25 multiple choice questions. Responses were received from people in each state and territory, with most respondents identifying as seed collectors.

The most important issues identified across all respondent groups were:

- Future demand for seed will be difficult to meet from wild harvest.
- The market is unwilling to pay for the true cost of seed collection/seed production.
- There is a lack of seed available from a broad range of species.
- Demand for seed is inconsistent and/or unpredictable.

Acacia terminalis **subsp.** ***terminalis*****. Photo: Gavin Phillip, Royal Botanic Gardens Sydney**

The survey highlighted several additional sector challenges including declining wild seed availability, climate change impacts, poor compensation for seed, and a small work force. Actions proposed to overcome these issues and challenges included; creating an industry body for the native seed sector, regional coordination, strategically expanding seed production areas, and improving market incentives.

Conclusions

The ANPC's national seed survey provided comprehensive findings and recommendations for the future development of the native seed sector. Survey participants were clearly passionate about the sector's future and were committed to helping facilitate better environmental outcomes while securing stable, productive careers. The results and recommendations from this survey should assist government policy development so it might help the sector grow, thrive and ultimately, contribute more to facilitating successful restoration of Australia's unique ecosystems.

To delve deeper into the native seed sector, download **The Australian Native Seed Survey Report** from the ANPC web page: https://www.anpc.asn.au/media-releases/where-will-the-seeds-come-from/

Next steps

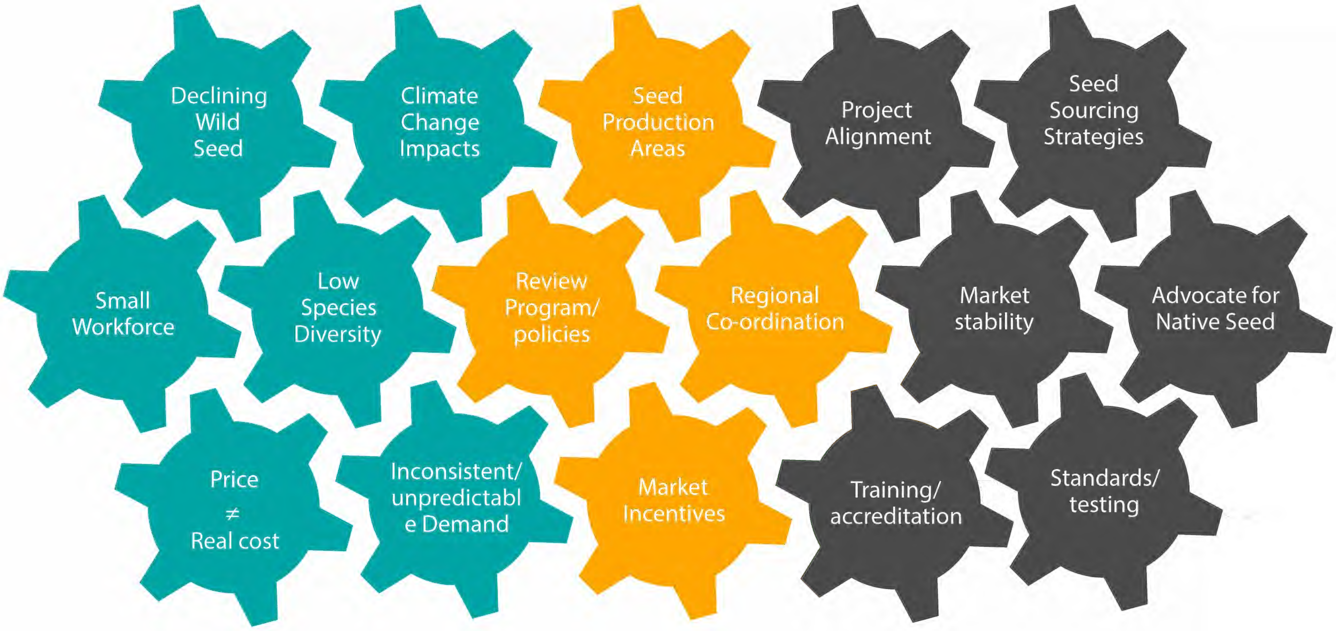
The Australian Native Seed Survey Report was released as part of the Healthy Seeds Project https://www.anpc.asn.au/healthy-seeds/. Under this project an audit of current Seed Production Areas in NSW has been completed. The results of this audit will be released in a future issue of the APC. For updates on the Healthy Seeds project and many others please subscribe to the Australian Network for Plant Conservation's free monthly e-newsletter: https://www.anpc.asn.au/anpc-news/

Acknowledgments

We would like to acknowledge the authors of The Australian National Seed Survey Report: Nola Hancock, Paul Gibson-Roy, Martin Driver and Linda Broadhurst.

Reference

Hancock. N., Gibson-Roy, P., Driver, M., and Broadhurst, L. (2020). *The Australian Native Seed Sector Survey Report*. Australian Network for Plant Conservation, Canberra.



Schematic representation of the Australian native seed sector. Blue cogs indicate *challenges and constraints* for the sector, yellow cogs indicate *actions required*, and grey cogs indicate *desired end-states* to achieve a more mature sector. Figure used with permission from Hancock *et al.* (2020).

ANPC member profile

Dr Lydia Guja

New ANPC Committee Member Lydia Guja. Photo: Mark Wallace

What is your current position?

I'm the manager of the National Seed Bank at the Australian National Botanic Gardens (ANBG) in Canberra. We are a team of four who curate collections of native seeds for long term conservation and research. In our conservation collecting we focus on Parks Australia's terrestrial reserves, and EPBC listed plant species and communities in and around the Australian Capital Territory. The research part of my role, which focuses on seed conservation biology, is conducted through the Centre for Australian National Biodiversity Research, a joint venture between ANBG and CSIRO.

What projects are you working on at the moment?

Some of the first major projects I undertook when joining ANBG focussed on threatened communities including Alpine Sphagnum Bogs and Associated Fens and Natural Temperate Grasslands. These plant communities are ongoing priorities for us. At the moment, I'm lucky to be involved in numerous projects investigating the seed biology and evolutionary ecology of Australian native plants right across the alpine, temperate, tropical and arid zones. My research utilises lab and field experiments to understand environmental conditions, genetic characteristics and functional traits that affect regeneration from seed. Research interests include:

- *Ex situ* plant conservation and optimising methods for seed banking and living plant collections.
- Understanding the environmental processes and cues that alleviate dormancy and promote germination.
- Applying novel imaging technologies in seed science research such as Z-stacked imaging to document and investigate functional seed traits, or X-ray mapping to understand morphology and physiology.
- Investigating comparative species biology, adaptive capacity, and environmental and genetic drivers of regeneration to inform conservation

How did you end up working in plant conservation?

I have always been interested in plants. My interest in nature led me to complete a BSc in Landscape Management at the University of Western Australia in Perth. During this course I became even more interested in botany, especially given I was lucky to be studying in Australia's South-West biodiversity hotspot with such an amazing range of plants to learn about. I took as many plant conservation units as I could, and I then completed a PhD at Curtin University and Kings Park and Botanic Garden on seed functional traits related to dispersal and germination under stress. Towards the end of my PhD I moved to Canberra to work with Parks Australia in the National Seed Bank and have been lucky enough to continue working on plant conservation projects covering many native plants.

What is your favourite plant and why?

It's too hard to choose one! Whenever I learn something new about a plant's biology it becomes a favourite. When I studied coastal plants, *Ficinia nodosa* amazed me with its ability to germinate in very high salinity by excluding salt from the seed embryo. Then I became impressed by alpine plants like *Richea continentis* and the way the tiny (0.9 x 0.4 mm) seeds can persist for years in the soil and germinate after being exposed to numerous seasonal changes in temperature. Then the threatened species *Pomaderris pallida* surprised me because it produces asexual seeds and they require unusually high temperatures to break dormancy and germinate. Then Norfolk Island's 44 EPBC listed plant species, many of them endemic to the island, captured my imagination because of the numerous unknowns regarding their reproductive and seed biology. Then…ask me next week and I'll have something else to tell you I'm sure.

Why do you think the ANPC network is important and what do you see as our priorities?

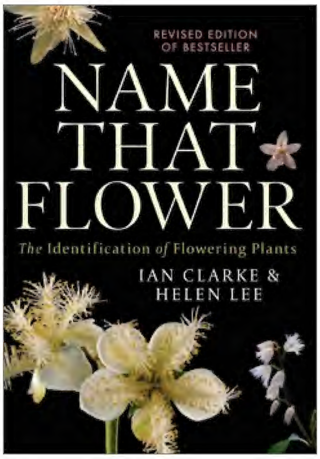
I think the ANPC network is important because it brings together individuals working in different disciplines essential for plant conservation (*e.g., ex situ* germplasm storage, land management, restoration, and biosecurity) so that relevant information can be shared. Further, the national focus and broad taxonomic interest of members allows synthesis of lessons at different scales. I think a key priority for ANPC is maximising the sharing of this collective knowledge, across disciplines and geographic regions, to ensure best-practice conservation especially in the face of emerging challenges such as new pathogens and a changing climate.

Book review

Name that Flower: The Identification of Flowering Plants: 3rd Edition

IAN CLARKE, HELEN LEE

PUBLISHED: 19 November 2019 | ISBN: 9780522876048 | PAGES: 374 | RRP: $39.99


REVISED EDITION OF BESTSELLER
NAME THAT FLOWER
The Identification of Flowering Plants
IAN CLARKE & HELEN LEE

Many field guides aim to attach as rapidly as possible a name to a specimen. Colour-coded page margins, species grouped by prominent but phylogenetically uninformative features, and other short-cuts help even the most casual of naturalists find a Latin binomial for a variety of organisms. It is a worthy service because there is satisfaction in naming the plants and animals that surround us, and any appreciation of nature will not be out of place as we test the resilience of nature as never before. And yet something is missing from a catalogue of names, however accurate.

Name that Flower, perhaps unexpectedly, given its title, is not primarily a short-cut to a name. Not that the book skimps on plant names nor on excellent drawings and photographs of flowers, but the aim of Ian Clarke and Helen Lee in the third and latest revision of their book lies, as it has in earlier editions, well beyond taxonomic labels. Their aim is to impart a framework for understanding flowering plant diversity. Seven chapters guide readers through a quick history of land plant evolution, present the variety of structure found in flowers and inflorescences as well as leaves and other vegetative parts, recount the history of plant nomenclature and classification through to the latest rearrangements of the Angiosperm Phylogeny Group (APG)—and then in chapter eight we are ready to name that flower we have found next to the footpath. It is perhaps the same spirit Mrs. Beeton brought to the art of cooking: surely one cannot prepare a fish dish without some knowledge of the natural history of the order Pisces.

The latter half of the book is organised around 46 plant families. It is a felicitous choice. Familiarity with even a dozen major families is enough to make sense of a good part of the diversity one encounters in the bush, in a garden, along the street. A few dozen more covers much of what a careful observer will find not just in Australia but in travels abroad. The focus on families is less daunting than hundreds of species would be, particularly to anyone just starting to learn about plants. Indeed, earlier editions of *Name that Flower* lead me to teach angiosperm diversity at the family level, in the hope that something of this framework stays with students who do not go on to careers in plant sciences. And nothing prevents a keen enthusiast from filling out the family-level framework with individual species.

This third edition expands the treatment of families given in previous editions and now includes a number of families with species cultivated here as ornamentals, or spreading as weeds, or planted as crops, with a focus on south-eastern Australia. It incorporates the latest understanding of angiosperm relationships as reflected in the APG delineation of families. Thus *Wurmbea* (Early Nancy), a genus with connections to South Africa and an interesting history of evolutionary adaptation to arid habitats along its dispersal pathway, is moved from the catch-all lily family, Liliaceae, and placed in the Colchicaceae, along with Australian native *Burchardia*, a locally important food for the earliest inhabitants of the continent. The distinctive Brunoniaceae with its sole representative, *Brunonia australis*, the Blue Pincushion, is lost and incorporated into the Goodeniaceae. And so on with updated classification. They reflect what the latest data, including DNA sequences, tell us about the evolutionary relationships among lineages, and that is the structure Clarke and Lee are keen for us to appreciate. Their family descriptions note the Australian and non-Australian family members, the most species-rich genera, economically important plants, and the relationships with other families.

What about naming flowers? In the end, we want a field guide to do that. The third edition has clean drawings, carefully labelled, with clear descriptions of floral and fruit structures and key characters that allow identification. New photographs of flowers and fruits, and micrographs of small parts, labelled to show special or difficult features, illustrate the expanded treatment of families. Botanical terminology is used because it is useful, but there is an excellent glossary and technical words are used in language that is more natural than often found in botanical literature. The aim is to open a world of insight into plants, not to fence it off.

New online resources for plant identification are noted along with a bibliography of technical taxonomic literature. *Name that Flower* was my introduction to the Australian flora. This third edition is a welcome updating and expansion of an already outstanding treatment of flowering plants. It has resources for beginners to professionals.

Martin Burd

News and conferences

ANPC News

APCC13 postponed to April 2022

The organising committee has made the difficult decision to postpone the 13th Australasian Plant Conservation Conference (APCC13) which was scheduled for 19 to 23 April 2021.

APCC 13

13th Australasian Plant Conservation Conference 2022

This decision was made based on the changing travel restrictions and social distancing measures which affect the organisation of and participation at this event.

When deciding to postpone the conference we considered various other formats but opted for a physical conference. This ensures the in-person networking opportunities this event provides are not constrained by social distancing or a virtual format.

The theme for the APCC13 conference is 'Seeds to Recovery'. A call for abstracts will be announced in 2021 with more information to be made available closer to the event.

To stay updated sign up to the ANPC newsletter **https://www.anpc.asn.au/anpc-news/** or check the conference web page **https://www.anpc.asn.au/conferences/apcc13/**.

We look forward to seeing you in 2022.

Florabank Guidelines Update

The update of the FloraBank Guidelines, as part of the Healthy Seeds Project, is progressing well. The draft modules are currently out for review. If you are interested in reviewing a module, please email ANPC Project Manager, Lucy Commander at florabank@anpc.asn.au. Further information on the update can be found at
https://www.anpc.asn.au/healthy-seeds/
https://youtu.be/Sr59Eq4dH50

Germplasm Guidelines Update

On the International Day for Biodiversity held 22 May 2020, the ANPC recognised the commitment of more than 50 Australian scientists to begin revising the ANPC's national Germplasm Guidelines for *ex situ* (off site) plant conservation, in keeping with the theme of this year's IDB celebration "Our solutions are in nature". These scientists will work together in hope and solidarity over the next year to update the Guidelines to capture advances in *ex situ* conservation over the last decade. *Ex situ* conservation supports *in situ* (on ground) management, particularly for threatened species, and targets are quantified within the Global Strategy for Plant Conservation (2011-2020). Australia aims to meet Target 8 with "At least 75 per cent of threatened plant species in *ex situ* collections, preferably in the country of origin, and at least 20 per cent available for recovery and restoration programs."
https://www.anpc.asn.au/germplasm-guidelines-review/

REVIEW OF
Germplasm
Guidelines
The Ian Potter Foundation
Australian Network for Plant Conservation Inc
CSIRO
AUSTRALIAN SEEDBANK PARTNERSHIP
AustralianGrainsGenebank
Australian National Botanic Gardens
bg anz
The Royal Botanic Gardens & Domain Trust
AUCKLAND BOTANIC GARDENS
Where ideas grow
ROYAL BOTANIC GARDENS VICTORIA
NSW GOVERNMENT

Plants Going Places – capacity building in the translocation of threatened native plants in Victoria

The ANPC has received a grant for two years from June 2020 from the Ross Trust. The grant will address the need to educate and inform both environmental scientists and practitioners on the translocation of threatened plants, for the benefit of Victoria's threatened plant species. Over the next two years, the project will present three, one-day plant translocation workshops in Melbourne, Ballarat and Bairnsdale, and produce three video site tours with accompanying public podcasts which will explore the stories of past and current translocation projects through the eyes of practitioners to investigate "What makes a translocation successful?". The aim is to significantly build capacity to successfully undertake translocations in Victoria (especially critical to post-fire recovery), increase awareness of threatened plants, help tackle 'plant blindness', and give voice to those people who work in this underappreciated field.

https://www.anpc.asn.au/plants-going-places/

Prevent Rare Plant Extinction and Reduce Impacts of Future Fires

In more exciting news, the ANPC has received funding from San Diego Zoo Global, with encouragement from the US Center for Plant Conservation, to prevent rare plant extinction and reduce impacts of future fires in eastern Australia. Narrow-range endemics and priority threatened plant species most sensitive to having recovery disrupted by repeated fires in the near future will be identified. Field inspections will quantify recovery and identify threats that need amelioration. Seed and/or vegetative germplasm will be collected and established at regional botanic gardens. Working with experts, land managers, indigenous consultants, and fire management authorities, we will assess fire regimes and impacted plant species, and develop a document 'Fire Regimes That Cause Biodiversity Decline' and web tools designed to provide guidance on recovery actions and build the resilience of biota to future fires. Draft strategies for at least 10 species will be developed to protect them from future fires and other threats during their sensitive recovery phases.

https://www.anpc.asn.au/prevent-rare-plant-extinction-and-reduce-impacts-of-future-fires/

Fire and Rust – Assessing the impact of Myrtle Rust on fire regeneration

This new project, funded by the Threatened Species Recovery Hub, aims to determine the susceptibility and impact of the rust fungus Myrtle Rust (*Austropuccinia psidii*) on Myrtaceae species regenerating after the 2019/20 bushfires. In cooperation with the Department of Agriculture and Fisheries Queensland and the NSW Department of Primary Industries, surveys will be conducted across a wide range of ecosystems and species in the fire affected regions of NSW and Queensland, including reserves in the Gondwana Rainforests of Australia World Heritage area. The growth of new epicormic shoots and young seedlings en-masse are ideal for the development and spread of Myrtle Rust. The project will identify the species showing susceptibility and the regeneration forms (re-shoots/seedlings) affected by the rust. The effect of repeated infection on species recovery/survival will be determined for species highlighted in priority lists, including bushfire affected threatened plants.

https://www.anpc.asn.au/fire-and-rust/

ANPC welcomes new Communications Manager!

Christine Fernance

The ANPC has welcomed Christine Fernance to the new role of Communications Manager, based at the ANPC Office at the Australian National Botanical Gardens one day a week. Christine has a background in marine science and broad skills in science communications. She is currently undertaking a Master of Science Communication at ANU. We are all thrilled to have her on board to help us improve our communications to all our loyal members and subscribers, and are looking forward to working with her. If you have any native plant conservation news you'd like to share or suggestions for ANPC News please send it through to Christine at communications@anpc.asn.au

https://www.anpc.asn.au/staff

Call for articles on plants and fire for *Australasian Plant Conservation* (APC)

Following the bushfires affecting large parts of Australia in 2019 and 2020, APC is seeking articles describing plant and ecological communities responses to fire (*e.g.,* fire-triggered seed germination, re-sprouting, structural and floristic community changes) and, where applicable, the impact of multiple fires and differing fire intensities, frequencies or seasons on plants and ecological communities. We are now calling for articles for the Summer issue of the APC bulletin. Short articles and/or post-fire articles with a pictorial focus are also welcome, as well as those on other plant conservation related themes. Deadline for the Summer edition is 1 November 2020.

https://www.anpc.asn.au/apc/

Post fire regeneration. Photo: Heidi Zimmer

New video on ANPC's Translocation Guidelines - Threatened Species Recovery Hub, 6 June 2020

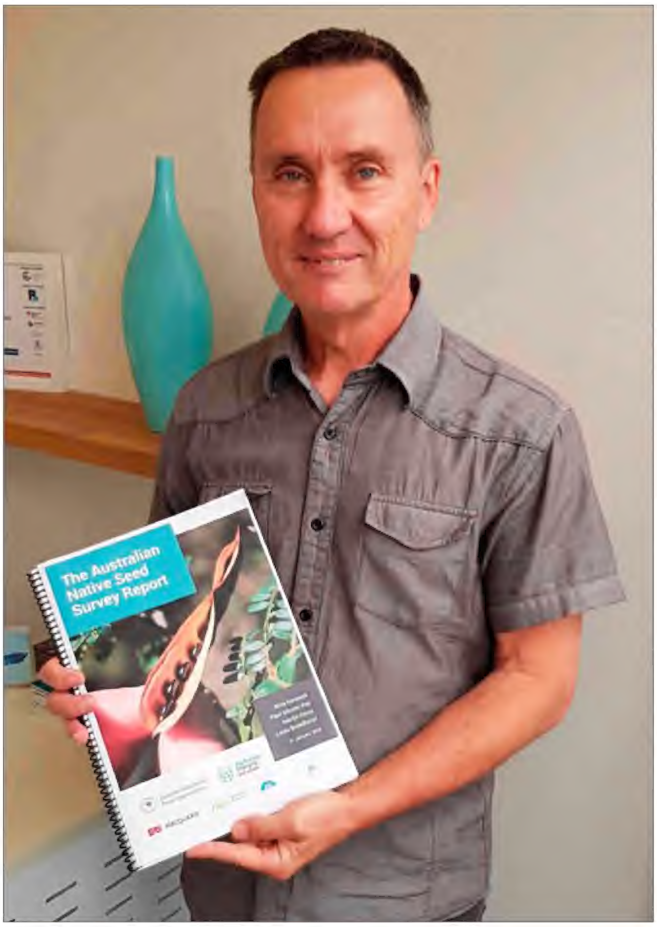
Hear from the ANPC's Dr Lucy Commander on our *Guidelines for the Translocation of Threatened Plants in Australia*. "The translocation guidelines help fight plant extinction because they are providing up to date information on all facets of translocation to ensure successful outcomes". The 3rd edition of the Guidelines provides a step-by-step guide for plant translocation and is a must-have for anybody involved in plant translocation.

https://www.youtube.com/watch?v=Rfgse5qKdy4and feature=youtu.be

Dr Paul Gibson-Roy talks about seed supply for restoration projects – Eastside 89.7FM, 19 May 2020

Listen to ANPC Committee member Dr Paul Gibson-Roy talk about seed supply for restoration projects with David Barr from Sydney's Eastside 89.7FM. Paul was one of the authors of the ANPC's recently released Australian Native Seed Survey Report which details the full results of a national survey capturing the behaviours and views of a wide range of native seed sector participants and has fed into our Healthy Seeds project.

https://www.anpc.asn.au/uncategorized/dr-paul-gibson-roy-talks-about-seed-supply-for-restoration-projects/


The Australian Native Seed Survey Report

Dr Paul Gibson-Roy with a copy of The Australian Native Seed Survey Report. Photo: Paul Gibson-Roy

Farming wildflowers; the future of restoration and native seed – Boiling Point podcast on Sydney's Eastside89.7FM, 3 June 2020

Let's learn how to better restore our landscapes using native seeds. Listen to ANPC Committee member and one of the authors the ANPC's recently published Australian Native Seed Survey Report, Dr Paul Gibson-Roy, talk about seeds and the results of the report which highlights issues in the native seed industry which must be overcome to ensure that seed-based restoration is more successful and sustainable into the future.
https://eastsidefm.org/podcast/farming-wildflowers-the-future-of-resoration-and-native-seed/

Restoration Seed Ecology with Dr Lucy Commander – Steam Powered, 30 May 2020

Dr Lucy Commander (tw: @lucy_commander), is a restoration seed ecologist who has spent over a decade undertaking scientific research with the mining industry to improve mine restoration. Lucy was also the lead editor of the ANPC's Guidelines for the Translocation of Threatened Plants, published in 2018, and is currently Project Manager for the update of the Florabank Guidelines for best practice native seed collection and use, with ANPC and partners. In our conversation, we talk about her interest in singing and gardening, restoration seed ecology, and her work as an editor on the Florabank Guidelines for best practice native seed collection and use.
https://www.youtube.com/watch?v=wYl8799VOXMandfeature=youtu.be

Collection of native Australian seeds. Photo: Lucy Commander

Australia's native guava plant close to being wiped out by invasive disease – study – The Guardian, 14 May 2020

Myrtle Rust has the potential to have the same impact on Australia's flora as feral cats and foxes have had on the country's fauna. Botanist and ANPC Committee member Bob Makinson says more work is needed to investigate the small numbers of native guava that are surviving "to see if there's any resistance traits out there" that could help push a natural recovery.
https://www.theguardian.com/environment/2020/may/14/australias-native-guava-plant-close-to-being-wiped-out-by-invasive-disease-study?fbclid=IwAR178gvHnKbTSf78xHDDxtJZX09ZvgG8uSxPBSjAPeql064v_4pdhie-5jl

Saving an Endangered wattle: Translocating Acacia cochlocarpa – Threatened Species Recovery Hub, 17 May 2020

Listen to ANPC Vice-President Dr David Coates talk about plant translocations in Western Australia.
For more information, read the ANPC's, *Guidelines for the Translocation of Threatened Plants in Australia* (3rd Edition) eds Commander, Coates *et al.* and Leonie and David's APC case study on *Acacia cochlocarpa* subsp. *cochlocarpa*, both available on the ANPC website. Known only from a single road-side location in Western Australia and with only 30 individual plants left, the spiral-fruited wattle was facing extinction. Dr David Coates and his team decided to attempt translocating it to establish a population at a new and safe location and to increase the number of plants. The team overcame some unknowns to establish a large and self-sustaining population.
The research has advanced our knowledge on achieving successful translocations and will be of value to the conservation of many other rare and threatened plants.
https://www.facebook.com/nespthreatenedspecies/videos/194086758298437/

Australasian Seed Science Conference – Canberra ACT, 5–9 September 2021

AUSTRALASIAN
Seed Science
Conference

As a result of the impact of the COVID-19 virus, the Australasian Seed Science Conference was postponed in April 2020.
Both early bird registration and abstract submission now open 9 November 2020. For more updated information please visit the Conference website and join our mailing list to keep up-to-date with new developments.
https://seedscience2020.com.au/

Plant cuttings – plant conservation news from around Australia

Editors' note: News excerpts are clipped from a diversity of sources. To read the articles in full follow the links attached to each clipping. The views expressed in these articles are those of their authors and do not necessarily represent the opinion of the ANPC.

Saving our Species program publishes new hygiene guidelines

The NSW Saving our Species program (SoS) recently published new hygiene guidelines to help reduce the risks associated with *Phytophthora cinnamomi*, Myrtle Rust, invasive terrestrial plants and amphibian chytrid fungus in NSW. The guidelines recommend which protocols you should incorporate into your fieldwork and when. They prioritise efforts where hygiene practices can reduce the entry of pathogens into unaffected areas that are suitable for establishment, are not subject to high human traffic and are habitat for susceptible species. Before heading out into the field, read the new hygiene guidelines from SoS and do your part to protect our natural environment.
https://www.environment.nsw.gov.au/topics/animals-and-plants/wildlife-management/wildlife-policies-and-guidelines/hygiene-guidelines

Volunteers wanted: Help Restore and Protect SA's Native Vegetation – Trees for Life

Trees For Life is a not-for-profit, community-based organisation working with everyday people to help restore our natural environment through revegetation and conservation. We have many volunteer and learning opportunities.
https://nrmjobs.com.au/jobs/2018/20000153/Volunteers_wanted_Help_Restore_Protect_SAs_Native_Vegetation?utm_source=NRMjobsandutm_campaign=00e922761c-NRMjobs%2C+5+April+2018_COPY_01andutm_medium=emailandutm_term=0_8cda2ee71f-00e922761c-17109365

Wildlife and habitat recovery funding for Queensland National Parks

Recovery actions for threatened plants and animals in Queensland bushfire-affected areas will receive $1.95 million in funding under the Australian Government's $50 million Wildlife and Habitat Bushfire Recovery package. The Federal Government's Wildlife and Threatened Species Bushfire Recovery Expert Panel has endorsed a range of priority actions established by the Queensland Government to be funded from the $1.95 million. Priority actions include protecting unburnt areas, on-ground assessments and emergency salvage of targeted species like the critically endangered Nangur Spiny Skink and pest and weed control in Oakview and Nangur National Parks, Bulburin National Park and Gondwana Rainforests.
https://www.environment.gov.au/biodiversity/bushfire-recovery

New IUCN Seed Conservation Specialist Group Website

The new IUCN Seed Conservation Specialist Group new website is now live! The mission of the Seed Conservation Specialist Group is to promote seed conservation by providing a network for knowledge-sharing in different ecosystems around the world, and aiding in prioritisation, capacity building, and development of best practices.
https://seedconservationsg.org/

Using a Zoo-based approach to botanic garden ex-situ plant conservation - Conservation Biology

The Chicago Botanic Garden and partners recently published an article in Conservation Biology, focused on using the zoo model for *ex situ* conservation to manage long-term *ex situ* populations of exceptional plant species at botanic gardens.
https://conbio.onlinelibrary.wiley.com/doi/full/10.1111/cobi.13503

Bush Blitz goes digital!

For the last decade, Bush Blitz, Australia's largest nature discovery program has taken taxonomists to remote parts of the country to document plants and animals. This program is a partnership between the Department of Agriculture, Water and the Environment, Parks Australia, BHP and Earthwatch Australia. Those who have participated in Bush Blitz have helped to discover more than 1700 new species and added thousands of species records. It's estimated there's between 580,000 and 680,000 species in Australia, with three quarters yet to be identified and scientifically described. With species discovery expeditions currently on hold due to

the pandemic, the Bush Blitz team has organised a virtual expedition to continue adding to our knowledge of Australian biodiversity while keeping everyone practicing their social distancing. This is a great activity to get involved in with your family and friends, and while we can't promise you'll find a new species, you will discover some amazing plants and animals living in your own backyard and learn how to identify them with the help of Bush Blitz scientists.
https://bushblitz.org.au/introducing-an-expedition-for-everyone/
https://www.youtube.com/watch?v=vgEoEkcRhYYandfeature=youtu.be

White Paper on Native Grasslands Conservation - US Wildlife Habitat Council

From small roadsides to vast landscapes, grassland habitats benefit corporate biodiversity and sustainability goals. Grasslands are one of the most common habitat types in the world and one of the most threatened. An opportunity exists for corporations to manage privately owned grasslands in nature-friendly ways that will realize multiple values for many stakeholders, including benefits to climate change mitigation and adaptation, stormwater run-off, cost savings and aesthetics.
https://www.wildlifehc.org/knowledge-resource/native-grasslands-conservation/

The fagus, Australia's only native winter deciduous tree, is turning its stunning autumn colours. What's behind that gorgeous display?

Every year at this time, thousands flock to national parks in Tasmania to see the stunning autumn display of Australia's only native winter deciduous tree — the fagus. But this year the state's parks are closed until further notice thanks to coronavirus, which means few will get to see the "turn of the fagus" with their own eyes. Kate Burton is one exception. She's been working as a ranger at Cradle Mountain National Park for six years and recently caught the first flush of the turn. "I'm witnessing something that will occur regardless of what's happening in our crazy world," Ms Burton said.
https://www.abc.net.au/news/science/2020-04-26/true-blue-autumn-leaves-are-turning/12147698

Home schooling led eight-year-old to rediscover long lost orchid

Eight-year-old Arabella Hanisch Jasiak was bushwalking in the Blue Mountains with her parents when she stumbled upon an orchid last seen more than 140 years ago. Her parents Ben Jasiak and Sabine Hanisch, who have authored books on the orchids of the Blue Mountains, knew immediately their daughter had made a rare find. Research scientist Mark Clements was able to confirm the orchid was the *Corunastylis reflexa*, last seen 145 years ago. "He (Mark Clements) is the king of Australian orchids so it was really exciting for Bella to help reinstate the species," Ms Hanisch told the Herald.
https://www.smh.com.au/environment/conservation/homeschooling-break-led-eight-year-old-to-rediscover-long-lost-orchid-20200429-p54ocs.html

Rare macadamia trees destroyed in Queensland bushfires

A cluster of rare and important macadamia trees that were already at risk of disappearing has been destroyed by bushfires in Queensland. Denise Bond and her team at the Macadamia Conservation Trust watched nervously as fires edged closer to the Bulburin National Park last summer. It was there that 150 rare *Macadamia jansenii* trees were discovered in 2018. "(It) only grows along this eight-kilometre stretch of one creek in the Bulburin National Park, so we were very concerned when we saw fire getting close," Ms Bond said on Wednesday. When she and her team were finally able to reach the burnt-out area in April, they were devastated by what they saw: a third of the trees were gone. That small patch of trees made up a quarter of the wild population.
https://www.smh.com.au/national/queensland/rare-macadamia-trees-destroyed-in-queensland-bushfires-20200430-p54ohn.html

Farmers set to appeal land clearing ruling against farm partly owned by MP Angus Taylor

Farmers are set to appeal the Government verdict that they used herbicide to remove critically endangered grasslands on a farm partly owned by MP Angus Taylor. The Federal Department of Environment has issued a determination against several farmers in the Snowy Mountains region of New South Wales who used herbicide to remove a critically endangered grassland in 2016.
https://www.abc.net.au/news/rural/2020-05-01/farmers-to-appeal-taylor-grassland-finding/12206728

Protecting plant species in the wake of bushfires

A seedbank at the Royal Botanic Gardens is being used to protect rare and endangered plants in the wake of the Victorian bushfires, among them tiny orchids and unusual shrubs under threat of extinction. Tim Entwisle, Director of the Royal Botanic Gardens Victoria.
https://www.abc.net.au/radionational/programs/blueprintforliving/protecting-plant-species-in-the-wake-of-bushfires/12201122

Emergency weed eradication project

MidCoast Council's Weed Biosecurity Officers are currently working on an emergency response to an outbreak of Tropical Soda Apple, an extremely invasive weed. Recent inspections across the MidCoast have detected multiple instances of the weed on both private properties and roadsides, particularly in the Wingham, Mt George, Number One and Cooplacurripa areas.

"Given how aggressive this perennial shrub is and its potential to cause harm to our agricultural production areas and invade natural areas displacing native plants and disrupting our natural ecological processes, we are implementing emergency actions to contain the outbreaks and kerb the spread of this dangerous weed," said Council's Strategic Weed Biosecurity Officer, Terry Inkson.

https://www.midcoast.nsw.gov.au/News-Media/Emergency-weed-eradication-project?fbclid=IwAR1DgqkukK-oQ3hoB0DwlKC3EH1C_CVwLRrsGAh0d6iaTs1od2-pntflG3s

'Perfect haven' emerges after 14-year effort to weed Sydney parkland

A delicate dance has been under way at Sydney Olympic Park for more than a decade as workers extract exotic weeds but not so fast that returning native birds and animals are left exposed to feral predators. In recent days, staff have pulled out the last of the lantana, ending a 14-year battle to eliminate the invasive weed from more than 20,000 square metres of the Brickpit....As the lantana has been hacked out, workers have planted more than 50,000 native plant seedlings to reinforce what is one of Sydney's most diverse patches of wildlife. The park is home to three endangered ecological communities - such as the Sydney Turpentine-Ironbark forest - and boasts more than 400 native plant species and in excess of 250 species of native animals.

https://www.smh.com.au/environment/conservation/perfect-haven-emerges-after-14-year-effort-to-weed-sydney-parkland-20200507-p54qxq.html

In the middle of coronavirus, two botanists went on a race against time to witness Tasmania's pencil pines seed

James Wood is looking for a tree. He's surrounded by trees on The Overland Track — gnarled myrtle beech, spindly snow gum — but he's looking for one tree in particular. Time is short. Steely clouds are tearing at the dolerite peaks of Tasmania's Cradle Mountain-Lake St Clair National Park, portents of rain, but there is another reason for haste. A pencil pine can live a thousand years but the ancient tree bears its seed cones only sporadically. This rare event, known as "masting", last took place in 2015. Now, in the midst of a global pandemic, it's happened again. The seed-bearing won't last long — "If you're not there at the right time you miss it," Wood laments — and nobody knows when it will next occur.

https://www.abc.net.au/news/2020-05-11/pencil-pines-in-tasmania-seeding-botanist-coronavirus/12228912

This rainforest was once a grassland savanna maintained by Aboriginal people – until colonisation

If you go to the Surrey Hills of northwest Tasmania, you'll see a temperate rainforest dominated by sprawling trees with genetic links going back millions of years. It's a forest type many consider to be ancient "wilderness". But this landscape once looked very different. The only hints are a handful of small grassy plains dotting the estate and the occasional giant eucalypt with broad-branching limbs. This is an architecture that can only form in open paddock-like environments – now swarmed by rainforest trees. These remnant grasslands are of immense conservation value, as they represent the last vestiges of a once more widespread subalpine "poa tussock" grassland ecosystem.

https://theconversation.com/this-rainforest-was-once-a-grassland-savanna-maintained-by-aboriginal-people-until-colonisation-138289

$150 million funding boost for bushfire affected wildlife and plants

The Morrison Government has taken its investment in bushfire recovery for native wildlife and habitat areas to more than $200 million. Delivering on the promise for additional funding based on expert research, Prime Minister Scott Morrison has announced $150 million on top of the $50 million initial recovery package.

The unprecedented environmental disaster response will help secure the future of treasured native species from the Koala to the Kangaroo Island Dunnart and the Northern Corrobboree Frog, as well as unique plants such as the Wollemi Pine, Banksias and Bottlebrushes.

https://minister.awe.gov.au/ley/media-releases/150-million-funding-boost-for-bushfire-affected-wildlife-and-plants

South Australian ecologist creates vegetation regeneration program to reduce bushfire risk

Joan Gibbs is happy to be called a "tree hugger", but she has not forgotten what lies beneath the canopy. The ecologist from the University of South Australia says grass is a crucial — and often overlooked — part of any ecosystem, particularly when it comes to mitigating bushfire risk. "Ninety-seven per cent of the biodiversity on earth is in the top 10 centimetres of soil," she said. "If we ignore the soil, then we don't get the whole system functioning." With that ethos, she has embarked on a "pilot regeneration program" on her 70-acre property, which was devastated by the summer's Cudlee Creek bushfire.
https://www.abc.net.au/news/2020-05-17/restoring-ecosystem-with-grasses-following-bushfires/12248034

After the bushfires, we helped choose the animals and plants in most need. Here's how we did it

No other event in our lifetimes has brought such sudden, drastic loss to Australia's biodiversity as the last bushfire season. Governments, researchers and conservationists have committed to the long road to recovery. But in those vast burnt landscapes, where do we start? We are among the wildlife experts advising the federal government on bushfire recovery. Our role is to help determine the actions needed to stave off extinctions and help nature recover in the months and years ahead. Our first step was to systematically determine which plant and animal species and ecosystems needed help most urgently. So let's take a closer look at how we went about it.
https://theconversation.com/after-the-bushfires-we-helped-choose-the-animals-and-plants-in-most-need-heres-how-we-did-it-138736

Orchid fever as 10-year quest finally unlocks Queen of Sheba's secret

Orchid hunters are a real group of people, and Western Australia is one of the best places in the world to be one – especially when one of the world's most rare and spectacular specimens is primed for a comeback. The orchid family is the largest plant family in the world with 25,000 species, but the greatest diversity of species is in only a few spots globally, according to Kings Park orchid conservation scientist Belinda Davis. One of these is the biodiversity hotspot that is WA's South West. The state is home to almost 400 orchid species, nearly three-quarters of which are endemic, meaning they don't occur anywhere else. Of those, 77 are of conservation concern. One of the rarest is the Queen of Sheba, the holy grail for orchid people – colourful characters, according to Dr Davis.
https://www.smh.com.au/national/orchid-fever-as-10-year-quest-finally-unlocks-queen-of-sheba-s-secret-20200521-p54vb6.html

ACT grasslands and woodlands listed as critically endangered

Swathes of wood and grasslands across the ACT have been officially designated as "critically endangered". On the advice of a panel of scientists, the ACT government said it was particularly worried about two types of area: "Natural Temperate Grassland" and "Yellow Box - Blakely's Red Gum Grassy Woodland". The ACT government is trying to balance increasingly powerful forces: the fierce desire for land for housing versus the desire by many to keep at least remnants of nature within a fast-growing city. The ACT's Environment Minister Mick Gentleman said of the newly designated areas: "their transfer to Critically Endangered will help preserve some of Australia's largest woodlands and grasslands."
https://www.canberratimes.com.au/story/6768589/act-grasslands-and-woodlands-listed-as-critically-endangered/

Cochineal insects released to destroy rampant Hudson pear cactus near Lightning Ridge

The hunt for a natural predator to take down a rampant cactus in western NSW is over. After years of research and breeding, biocontrol experts are ready to release a tiny insect to destroy the thorny Hudson pear near Lightning Ridge. Landcare cactus coordinator Jo-Anna Skewes said the tiny insect, *Dactylopius tomentosus*, belonged to the cochineal family. "Our trial work shows the insect distributes really well in the wind, which is what we want to see," Ms Skews said.
https://www.abc.net.au/news/rural/2020-05-26/hudson-pear-biocontrol-insect-released-lightning-ridge/12271508

Summer bushfires an ecological disaster

Hundreds of animal and plant species have been impacted by Australia's devastating Black Summer bushfires, with some now at increased risk of extinction because of the ecological disaster. More than 300 nationally-listed threatened species were in the path of the fires, the bushfires royal commission has been told. "The impact of the 2019-20 bushfires on threatened species and other flora and fauna has been severe," Commonwealth threatened species commissioner Dr Sally Box told the inquiry on Wednesday. An expert advisory panel has labelled the bushfires an ecological disaster. "The fires covered an unusually large area and in many places they burnt with an unusually high intensity," Dr Box said. "The entire known range of some species was burnt."
https://www.canberratimes.com.au/story/6770951/summer-bushfires-an-ecological-disaster/

Conservationists push to save Banksia vincentia from extinction

Conservationists from around the country are working to save a critically endangered species of banksia from extinction. Fourteen *Banksia vincentia* plants were discovered 15 years ago in the New South Wales South Coast town of Vincentia. But now, with only four remaining in the wild, conservationists from the Booderee, Wollongong, Australian, and National Botanic Gardens are collaborating to keep the species alive. "In NSW the plant has been declared critically endangered, which in terms of conservation and declaration, is a rarity," Booderee Botanic Gardens acting curator Stig Pedersen said. "This is the last stage before it's deemed extinct."
https://www.abc.net.au/news/2020-05-28/push-to-save-banksia-vincentia-from-extinction/12292550

Bushfire royal commission: Fire damaged prehistoric Wollemi Pines but most saved from major destruction

The commission heard a cluster of critically endangered Wollemi Pines — the location of which is a closely guarded secret — suffered minor damage from fires at the end of last year. The pines, often called 'dinosaur trees', date back to the Jurassic Period and were thought to be extinct before they were rediscovered in 1994. Only 100 mature plants are alive in the wild. David Crust from New South Wales National Parks and Wildlife Service said a number of measures, including constant irrigation and fire-retardant drops, were put in place to protect the trees. "What the image doesn't show is most of the understory below the canopy did burn with varying degrees of intensity," he said referring to an aerial image of the pine cluster.
https://www.abc.net.au/news/2020-05-27/bushfire-royal-commission-summer-ecological-disaster-wildlife/12290454

Native Rooftop Farm

On a rooftop in inner-city Sydney there is a hidden oasis of a garden, featuring more than 30 species of edible, medicinal or culturally significant plants. This is Australia's first Indigenous-run rooftop farm, sitting on 500 square metres atop a 4-storey building. Clarence notes that the design of the project "combines indigenous knowledge, collaborative design and permaculture principals".
Its primary purpose is a demonstration farm and cultural space. It also aims to improve biodiversity in the city by providing food and habitat for insects and birds, to improve the wellbeing of humans visiting the space and to research the suitability of local plant species for public plantings.
https://www.abc.net.au/gardening/factsheets/native-rooftop-farm/12295938

Plant Profile - Murnong (Yam Daisy)

Millie is in the NSW alpine region on Walgalu Country, looking at a plant that has been cultivated by First Nations people for tens of thousands of years. It is a new and exciting plant that many Australian gardeners are growing for the first time. Murnong *(Microseris sp.*), also called the yam daisy, is a grasslands plant that produces edible tuberous roots. It can be hard to identify in the wild because it looks like a lot of other yellow daisy plants, including dandelions and flatweed, also called cats ears. Millie points out the main differences: flat weed has a rosette of hairy, wavy-edged leaves that sit flat on the ground, while murnong has upright lance-shaped leaves. Murnong flower stems have a curved, drooping top as the bud develops, then straighten as it opens, whereas flatweeds and dandelions are upright as the bud is forming.
https://www.abc.net.au/gardening/factsheets/plant-profile---murnong-(yam-daisy)/12297732

Ikara Inheritance

Sophie visits Adelaide Botanic Gardens (on Kaurna country) to see plants from the Ikara-Flinders Ranges (Adnyamathanha country) and learn about the work of the seed conservation centre. The collection grows in a special pocket of the gardens, built using 30 tonnes of rock, creating a microclimate that mirrors their

native environment. All the plants are growing from wild-harvested seed. Seed biologist Daniel Duval explains that many of the plants are rare or endangered in the wild so are hard to see, which is why the Botanic Gardens has chosen to display them. There are 40 species growing in the collection including the daisy *Ixodia flindersica* and the wax-flower *Philotheca difformis*. There are also plants that are undescribed (not yet formally named), including a pea plant with an unusual flower from the Gammon ranges area of the Flinders Ranges, from the genus Tephrosia.
https://www.abc.net.au/gardening/factsheets/ikara-inheritance/12297460

Plant Me Instead

Josh is on Whadjuk Country, where he visits a native plant nursery to provide some local alternatives to environmental weeds that are hiding in everyday gardens. In Australia, weeds are among the top threats to Australian biodiversity. They can displace native plant species, degrade habitat for native animals, harbour pests and disease, create fuel loads for fires and compete with native species for space, water and nutrients. Some 65% of the exotic weedy species in Australia started out as garden plants and gardens comprise the major pool of future weeds. Some of these can still be found for sale, which means that as gardeners, we have a crucial role to play in stopping garden escapes at their source – by choosing to grow non-invasive species instead.
https://www.abc.net.au/gardening/factsheets/plant-me-instead/12297458

Critically endangered herb thriving on Macquarie Island after seven-year feral animal eradication program

A critically-endangered herb once thought extinct on sub-Antarctic Macquarie Island has been found growing at a new location as the world-heritage site continues its rabbit-free recovery. The remote island was declared free of pests in 2014, following a seven-year feral animal eradication project. *Galium antarcticum*, a type of flowering bedstraw, was thought to have died out in the early 1980s until 500 plants were discovered in 2013 at Skua Lake near the island's west coast. In May, three new populations in close proximity to each other were discovered about 7km to the south.
https://www.theguardian.com/environment/2020/jun/01/critically-endangered-herb-thriving-on-macquarie-island-after-seven-year-feral-animal-eradication-program

Backyard gardeners help save the Wollemi Pine

As bushfires blackened forests last summer, one tree species was protected by a specialist team of firefighters: the Wollemi pine. These trees have a deeply ancient lineage dating back to when dinosaurs walked Gondwana 100 million years ago. Back then, rainforests – including Wollemi pines (or their cousins) – covered what became Australia. So when a handful of Wollemi pines were discovered alive in 1994 on the brink of extinction, it caused a frenzy of interest that has barely died down among plant enthusiasts.
https://theconversation.com/backyard-gardeners-around-the-world-are-helping-to-save-australias-deeply-ancient-wollemi-pine-138797

Logging and fire both make forests more flammable

The clear and overwhelming evidence is that logging makes forests more flammable. These are the findings of four peer-reviewed, published scientific studies from four institutions in six years, and of multiple scientific reviews. The likely reasons are that after logging, increased sunlight dries out the forest floor, thousands of fast-growing saplings per hectare increases the fuel for a fire to burn, and the wind speed on hot days increases because of the lack of a tree canopy (wind speed is a key factor in creating extreme fire conditions). Most branches that burn in a bushfire are smaller than the diameter of a human thumb. Young trees burn almost completely while big, tall trees often remain alive and standing after fire.
https://www.smh.com.au/environment/climate-change/logging-and-severe-fire-both-make-forests-more-flammable-20200605-p5500y.html

Neil Hoffman awarded a medal of the Order of Australia

Neil Hoffman, who the *Caladenia hoffmani* orchid species was named after, was awarded a Medal of the Order of Australia for his "service to the conservation of native orchids". Noel Hoffman saw his first orchid when he was six years old and since then the 88-year-old has dedicated his life to discovering, photographing and documenting as many species as possible.
https://www.facebook.com/abcperth/posts/3355085981191005

Taxonomic evaluation of Ptilotus manglesii (Amaranthaceae) and recognition of *P. davisii* for two phrase names in south-west Western Australia

Western Australian botanist Tim Hammer describes a new species of Ptilotus that is closely related to *P. manglesii*. The two species are illustrated and the nomenclatural history and typification of the two species is discussed.
https://data.environment.sa.gov.au/Content/Publications/JABG33P103_Hammer.pdf

The coastal banksia has its roots in ancient Gondwana

If you fondly remember May Gibbs's Gumnut Baby stories about the adventures of Snugglepot and Cuddlepie, you may also remember the villainous Big Bad Banksia Men (perhaps you're still having nightmares about them). But banksias are nothing to be afraid of. They're a marvellous group of Australian native trees and shrubs, with an ancient heritage and a vital role in Australian plant ecology, colonial history and bushfire regeneration.
https://theconversation.com/the-coastal-banksia-has-its-roots-in-ancient-gondwana-138434

Plant profile: Red-flowering Kurrajong

A short video introduces the Red-flowering Kurrajong (*Brachychiton megaphyllus*) and endemic to Australia's Top End this plant was listed as the official emblem of the city of Darwin in 1988.
https://www.abc.net.au/gardening/factsheets/plant-profile:-red-flowering-kurrajong/12348530

Precious nightcap oak survives the carnage of bushfire with show of uplifting resilience

A stand of Gondwana-era trees ravaged by bushfire last year is showing what it takes to be one of nature's great survivors. The critically endangered nightcap oak has survived in the rainforests of northern New South Wales since the Eocene epoch, about 40 million years ago.
The species *Eidothea hardeniana* first emerged when Australia and Antarctica were a single land mass and it has thrived through climatic extremes and across the aeons as its habitat drifted slowly northwards. But late last year its damp forest home experienced something new.
https://www.abc.net.au/news/2020-06-15/ancient-nightcap-oak-natures-great-survivor/12353034

Planting non-native trees accelerates carbon release

Large-scale reforestation projects such as New Zealand's One Billion Trees programme are underway in many countries to help sequester carbon from the atmosphere. But there is ongoing debate about whether to prioritise native or non-native plants to fight climate change.
As our recent research shows, non-native plants often grow faster compared to native plants, but they also decompose faster and this helps to accelerate the release of 150% more carbon dioxide from the soil. Our results highlight a challenging gap in our understanding of carbon cycling in newly planted or regenerating forests.
https/theconversation.com/planting-non-native-trees-accelerates-the-release-of-carbon-back-into-the-atmosphere-139841

Urgent need for an integrated policy framework for biodiversity loss and climate change

Chris Turney, Anne-Gaelle Ausseil and Linda Broadhurst recently published a correspondence piece in Nature Ecology and Evolution. They highlight the failure of the international community to mitigate the impacts of climate change and biodiversity loss.
https://www.nature.com/articles/s41559-020-1242-2

Native smokebush plant adapts to allow for ant pollination

Ants have been observed behaving in unusual ways in Western Australia, doing work that is normally the domain of bees. Edith Cowan University PhD student Nicola Delnevo was investigating plant-pollinator interaction on threatened plant species of the Swan Coastal Plain, when he noticed something unusual on the white flowers of Conospermum plants.
https://www.abc.net.au/news/2020-06-19/unique-wa-plants-adapt-to-allow-for-ant-pollination/12350088

Volunteers called to help plant 50,000 seedlings in fight to conserve Ludlow Tuarrt Forest

Between Busselton and Bunbury stands Ludlow Tuart Forest, the largest remaining forest of its kind in the world with trees soaring more than 33m into the sky. But while tall and mighty, the tuarts are facing a conservation crisis, last year listed as "critically endangered" following decades of land clearing, the timber industry, farming and urban sprawl restricting the population to ever smaller pockets. Despite the pouring rain last week,

volunteers from across the region came out in droves to plant some 50,000 seedlings to restore stands of the iconic South West species.
https://www.swtimes.com.au/news/south-western-times/volunteers-called-to-help-plant-50000-seedlings-in-fight-to-conserve-ludlow-tuart-forest-ng-b881577942z?fbclid=IwAR2Iti-hLlwV84HZFVkNAXXceENRpuwI-wQyndWxx3LSyUlArHYKdQee7ha8

At your feeding stations: Bushfire weed alert

A call has been put out for people to look out for weed seeds germinating and spreading into bushland after the fires in NSW and Victoria. Australia saw an incredible response from people putting out feed for wildlife to survive in the aftermath of last summer's deadly bushfires, but some feed carried weedy seed. Bare, burned and open ground is an ideal place for plants to grow – native plants and weeds. Native wildlife will need healthy, native bushland as part of recovery efforts, weeds often outcompete and displace our native plants.
https://invasives.org.au/blog/bushfire-weed-alert-after-wildlife-rescue/

Tackling Australia's environmental crisis

Australia's key national environmental law, the Environmental Protection and Biodiversity Conservation Act 1999, is currently undergoing a once-in-a-decade independent review. The Prime Minister and federal Environment Minister have vowed to cut 'green tape' to speed up approvals for development projects, but conservationists worry that any move to weaken the law will worsen Australia's environmental plight. So what's the right way forward?
https://www.abc.net.au/radionational/programs/latenightlive/tackling-australias-environmental-crisis/12389374

Drought-breaking rains transform endangered woodlands into a flower-filled vista

After Queensland's drought-breaking rain earlier this year, scientists surveyed private farmland and found many dried-out woodlands transformed into flower-filled landscapes. In the box gum grassy woodlands, widely spaced eucalypts tower over carpets of wildflowers, lush native grasses and groves of flowering wattles.
It's no wonder some early landscape paintings depicting Australian farm life are inspired by this ecosystem. But box gum grassy woodlands are critically endangered. These woodlands grow on highly productive agricultural country, from southern Queensland, along inland slopes and tablelands, into Victoria.
https://www.australiangeographic.com.au/topics/science-environment/2020/06/drought-breaking-rains-transform-endangered-woodlands-into-a-flower-filled-vista/

Auditor-General's review of EPBC Act finds severe deficiencies in Environment Department's processes

Almost 80 per cent of federal environmental approvals examined in a high-level review were non-compliant or contained errors, Australia's audit office says.
In what conservationists have described as a "scathing indictment" of the Federal Government's handling of environmental protection, the Australian National Audit Office (ANAO) found the Department of Agriculture, Water and the Environment did not have adequate measures in place to oversee the national environment laws. The Environment Protection and Biodiversity Conservation (EPBC) Act was put in place in 1999 to protect world heritage sites, biodiversity and other significant land and sea areas. But the review concluded that in the decades since, administration of the Act had been poorly handled.
https://www.abc.net.au/news/2020-06-25/auditor-general-severe-deficiencies-environmental-protection/12393780

Climate change threat to tropical plants

Half of the world's tropical plant species may struggle to germinate by 2070 because of global warming, a new UNSW study predicts. Tropical plants closer to the equator are most at risk from climate change because it is expected to become too hot for many species to germinate in the next 50 years, UNSW researchers have found. The research, published in the journal Global Ecology and Biogeography last month, was the first to look at the big picture impact of climate change on such a large number of plant species worldwide.
https://newsroom.unsw.edu.au/news/science-tech/climate-change-threat-tropical-plants

Emergency actions as drought hits critically endangered plant in Mount Kaputar National Park

The National Parks and Wildlife Service and the Australian Institute of Botanical Science recently took emergency action after drought severely impacted a critically endangered plant in Mount Kaputar National Park. National Parks and Wildlife Service (NPWS) Project Officer James Faris said emergency measures were enacted under the NSW Government's Saving our Species program, when it was discovered just three adult plants of *Zieria odorifera* ssp. *copelandii* remained. **https://www.environment.nsw.gov.au/news/emergency-actions-as-drought-hits-critically-endangered-plant-in-mt-kaputar-national-park**

When did flowering plants take over the world?

When you see a plant, it's likely that nine out of 10 times you will be looking at a flowering plant. Flowering plants, or angiosperms as they are also called, make up 90 per cent of the world's plant species. That's some 300,000 to 400,000 species of angiosperms, depending on who you ask. A new global study published today in Nature Ecology and Evolution, of which Dr Ramirez-Barahona is the lead author, has revealed the first complete evolutionary tree of the 435 flowering plant families. **https://www.abc.net.au/news/science/2020-07-07/flowering-plants-complete-evolutionary-tree/12425054**

After last summer's fires, the bell tolls for Australia's endangered mountain bells

Hidden in the Stirling Range national park in Western Australia – an area so diverse, so ecologically important, I've described it as a "coral reef out of water" – are Australia's spectacular mountain bells. These breathtaking native Australian flowers are now at grave risk from recent fires, with many species listed on the government's provisional list of plants requiring urgent management intervention. The Stirling Ranges were ravaged by this summer's fires, and three-quarters of this WA national park now experience fire cycles twice as frequent as species recovery rates. **https://theconversation.com/after-last-summers-fires-the-bell-tolls-for-australias-endangered-mountain-bells-139665**

Botanist Kingsley Dixon warns WA plants could be lost forever, but there is hope

Some of Western Australia's most vulnerable but "utterly unique" native flowers are at risk of being wiped out — but they can be saved by citizen botanists in their own backyards. That's the view of the Curtin University botanist Professor Kingsley Dixon, who said the plants, which were easily propagated, could be saved from extinction if enough green-thumbed Australians chose to plant them in their own gardens. **https://www.abc.net.au/news/2020-07-09/darwinia-endangered-plants/12436254**

Brush it off: the true cost of weeds

If you see a weed hygiene station on your travels – please use it. By brushing off your shoes, bike tyres and pets, you're helping protect Wagga Wagga's natural reserves from the insidious spread of weeds. Wagga Wagga City Council has installed an additional weed hygiene station along the Wiradjuri Trail and is asking the community to use them – both when joining the trail and leaving it. **https://wagga.nsw.gov.au/city-of-wagga-wagga/council/news/article-folder/july-2020/brush-it-off-the-true-cost-of-weeds?utm_source=miragenewsandutm_medium=miragenewsandutm_campaign=news**

Renewed Funding for plant biosecurity research

The Minister for Agriculture, Drought and Emergency Management, David Littleproud backed the future for plant health research in Australia with the announcement that funding for the Plant Biosecurity Research Initiative (PBRI) will be renewed in 2020, The International Year of Plant Health. The PBRI members signed a collaboration agreement for a further three years to coordinate and support plant biosecurity research in Australia. The partnership includes Australia's seven plant Research and Development Corporations, Plant Health Australia and the Department of Agriculture, Water and the Environment. **https://www.horticulture.com.au/hort-innovation/news-events/renewed-funding-for-plant-biosecurity-research/?utm_source=miragenewsandutm_medium=miragenewsandutm_campaign=news**

Origins of flowering plants mapped by time and place

The flowering plants or angiosperms, as distinct from conifers and ferns, emerged during the early cretaceous period, 145-100 million years ago. There was nothing like the today's diversity, where we see close to 400,000 species, representing 90% of all plants. As Suzannah Lyons reports, Santiago Ramírez-Barahona has mapped the origins of each family and shown the true flowering of the flowering plants. It occurred millions of years after the demise of the dinosaurs (approx. 60 million years ago), first in arid and temperate regions, then in the tropics. **https://www.abc.net.au/radionational/programs/scienceshow/origins-of-flowering-plants-mapped-by-time-and-place/12463178**

Interim report released for the Independent Review of the Environment Protection and Biodiversity Conservation Act 1999

The Interim Report of the Independent Review of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) has been released. The Interim Report sets out preliminary views on the EPBC Act and how it operates. It focuses on the fundamental problems of the legislation and proposes reform directions that are needed to address these. The Independent Reviewer, Professor Graeme Samuel AC, said "the Interim Report has been released part way through the Review as an opportunity to share and test thinking. The EPBC Act is ineffective. It does not enable the Commonwealth to protect and conserve environmental matters that are important for the nation. It is not fit to address current or future environmental challenges." **https://epbcactreview.environment.gov.au/news/media-statement-professor-graeme-samuel-ac-releases-interim-report**

Australia's first Indigenous Chair for Biodiversity and Environmental Science

The Biodiversity Chair will be the first of its type in Australia and one of only a few globally that directly engage with First Nations Peoples. A key focus of the position will be building a Western-Indigenous science interface, so that landscapes for threatened species can be managed in new ways that are sympathetic to the maintained stewardship provided, over the last 65,000 years, by the Aboriginal people. Curtin Vice-Chancellor Professor Deborah Terry said she is thrilled that a person of Professor van Leeuwen's outstanding scientific and national profile has accepted the prestigious role. **https://news.curtin.edu.au/media-releases/australias-first-indigenous-chair-for-biodiversity-and-environmental-science/**

The forgotten German botanist who took 200,000 Australian plants to Europe

It is not widely known that many Australian colonial natural history collections are represented in German museums and herbaria, nor that there are initiatives to transform these artefacts of colonial heritage and science back into objects from living cultures with living custodians and their own stories to tell. Dr Johann August Ludwig Preiss (1811–1883) played a significant role in this evolving story as the first professional botanist to collect systematically in the Colony of Western Australia from 1838 to 1842. His collections of flora and fauna were pivotal in opening this globally significant region of biodiversity to the world. **https://theconversation.com/friday-essay-the-forgotten-german-botanist-who-took-200-000-australian-plants-to-europe-143099**

Green Jobs Plan unveiled to support recovery

As part of the WA Recovery Plan, $60.3 million will be invested in the Green Jobs Plan over the next three years. The plan will support projects that will protect our environment and create more than 1,000 conservation jobs State-wide. $15 million has been allocated to set up a Native Vegetation Rehabilitation Scheme. In combination with the State's $8 million Offsets Fund for Recovery (OFFR) program, the scheme will target revegetation, habitat restoration and protection of existing vegetation. **https://www.wa.gov.au/government/announcements/green-jobs-plan-unveiled-support-recovery**

Our Knowledge Our Way in caring for Country: Indigenous-led approaches to strengthening and sharing our knowledge for land and sea management

The Our Knowledge Our Way in caring for Country Best Practice Guidelines, gives a voice to Indigenous land and sea managers who have found good ways to strengthen their knowledge and build partnerships for knowledge sharing in caring for Country. Indigenous Australians rights of ownership and management have been recognised over nearly half of Australia and their knowledge systems connect them to their Country and cultures. As significant landowners, managers and custodians, Indigenous peoples are applying their knowledge in caring for Country, generating many benefits. Indigenous peoples are learning from each about how to build on these successes. Researchers and policy makers tasked with solving Australia's complex environmental challenges are noticing many beneficial outcomes from Indigenous peoples applying their knowledge in management and seeking ways to grow these positive impacts. **https://www.csiro.au/en/Research/LWF/Areas/Pathways/Sustainable-Indigenous/Our-Knowledge-Our-Way**

Other conferences, courses and events

Updates available at
http://anpc.asn.au/other_conferences_and_events

Virtual Science Seminars – The Royal Botanic Garden Sydney

Normally held at The Calyx, our science seminars are now virtual. Join us to hear from world-renowned speakers and scientists from the Botanic Gardens and other organizations. One recent seminar was 'The Rainforest Seed Conservation Project' presented by Dr Karen Sommerville. In this seminar, Karen presented the results from testing over 300 species and discuss the difficulties encountered, the proportion of seeds that were suitable for standard or modified seed banking, and simple indicators that can be used to distinguish bankable from non-bankable seeds. To see upcoming presentations and watch previous seminars click here. **https://www.rbgsyd.nsw.gov.au/Science/Virtual-science-seminars**

Certificate III in Conservation and Land Management – Course update

The VET course in Conservation and Land management is being updated to combine the four existing Certificate III level qualifications into a single new Certificate III in Conservation and Land Management. This update is currently in the finalisation stage.
https://www.skillsimpact.com.au/horticulture-conservation-and-land-management/training-package-projects/conservation-and-land-management-project/

2021 National Landcare Conference rescheduled – 4 to 6 August 2021

The National Landcare Conference Steering Committee have agreed to postpone the 2021 National Landcare Conference date to mid-2021 to ensure that we can provide individuals, organisations and groups involved in Landcare, the best possible opportunity to attend the event in person. The new conference date will be held during 2021 Landcare Week – Wednesday 4 to Friday 6 August, 2021.
https://landcareaustralia.org.au/national-landcare-conference-2020/

Global Botanic Garden Congress – Melbourne VIC, 27 September – 1 October 2021

Botanic Gardens Conservation International (BGCI)'s Global Botanic Garden Congress is the only global congress dedicated to botanic gardens and is a key event in the calendar for botanic garden leaders and staff. It is an opportunity for the botanic garden community to come together and share information and experiences. Held every three or four years the Congress includes internationally renown plenary speakers and sessions covering topics relevant to botanic gardens such as policy, education, governance, conservation and research.
https://www.bgci.org/our-work/services-for-botanic-gardens/bgci-congresses/bgci-global-botanic-garden-congresses/

1st International Plant Translocation Conference – Rome Italy, postponed to 2022

The first International Plant Translocation Conference (IPTC) scheduled for 22-25 February 2021 in Rome has been postponed to 2022. The change of date is due to uncertainties related to the Coronavirus outbreak. The conference will be a unique occasion for conservation biologists from around the world to share their experiences, successes and misfortunes in restoring threatened plant species.
http://host.uniroma3.it/eventi/IPTC2021/

Please help us raise vital funds for native plant conservation following the summer bushfires

Post fire recovery at Wallabi Point on the NSW north coast. Photo: Jo Lynch

The 2019/20 catastrophic bushfires have had a huge impact on our unique plants and ecological communities. The ANPC is working hard this year to seek funding to help with their recovery through initiatives such as plant conservation workshops (eg. for threatened plant translocations), conducting field surveys, and producing online materials such as presentations, videos and showcasing affected species. We have already been successful with three exciting new projects (see ANPC News). We are also publicising post-fire information, projects and research through *Australasian Plant Conservation* and our e-newsletter ANPC News.

Please make a generous donation today and help us promote and improve plant conservation in Australia during this difficult time. **https://www.anpc.asn.au/donate/**

Presenters and participants at an ANPC plant translocation workshop. Photo: Kylie Moritz

Some of our other high priority projects for 2020 include:

- improving the supply of native seed in NSW and updating the 'Florabank Guidelines' through our Healthy Seeds project, supported by the NSW Environmental Trust.
- promoting our recently launched 'Australian Native Seed Survey Report'.
- reviewing and updating our Germplasm Guidelines supported by The Ian Potter Foundation.
- planning the 13th Australasian Plant Conservation Conference (APCC13) to be held in Albury, dates to be confimed, hosted by Albury City Council.
- our two orchid conservation projects with Royal Botanic Gardens Victoria: Saving the threatened Audas Spider-orchid (*Caladenia audasii*) from extinction; and Saving the Brilliant Sun Orchid (*Thelymitra mackibbinii*) from extinction.
- promoting and distributing our new 3rd edition of the 'Guidelines for Translocation of Threatened Plants in Australia'.

All donations $2 or above are tax deductible.

https://www.anpc.asn.au/donate/

Research round up

COMPILED BY TOM LE BRETON

University of New South Wales.

Barros, A., Aschero, V., Mazzolari, A., Cavieres, L.A. and Pickering, C.M. (2020). **Going off trails: How dispersed visitor use affects alpine vegetation.** *Journal of Environmental Management*, 267: 110546. https://doi.org/10.1016/j.jenvman.2020.110546

Bradshaw, S.D., Dixon, K.W., Lambers, H., Cross, A.T., Bailey, J. and Hopper, S.D., (2018). **Understanding the long-term impact of prescribed burning in mediterranean-climate biodiversity hotspots, with a focus on south-western Australia.** *International Journal of Wildland Fire*, 27(10): 643-657. https://doi.org/10.1071/WF18067

Brundrett, M. (2020). **A proposed framework for efficient and cost-effective terrestrial orchid conservation.** (Preprint) Website: *www.Preprints.org* . https://doi.org/10.20944/preprints202004.0465v1

Burrows, N., Rampant, P., Loewenthal, G. and Wills, A. (2020). **Fire, plant species richness and plants of significance to Australian desert Aboriginal people.** *International Journal of Wildland Fire*.

https://doi.org/10.1071/WF20057

Bryan-Brown, D.N., Connolly, R.M., Richards, D.R., Adame, F., Friess, D.A. and Brown, C.J., (2020). **Global trends in mangrove forest fragmentation**. *Scientific Reports*, 10(1): 1-8. https://doi.org/10.1038/s41598-020-63880-1

Carlier, J., Davis, E., Ruas, S., Byrne, D., Caffrey, J.M., Coughlan, N.E., Dick, J.T. and Lucy, F.E. (2020). **Using open-source software and digital imagery to efficiently and objectively quantify cover density of an invasive alien plant species.** *Journal of Environmental Management*, 266: 110519. https://doi.org/10.1016/j.jenvman.2020.110519

Chase, J.M., Jeliazkov, A., Ladouceur, E. and Viana, D.S. (2020). **Biodiversity conservation through the lens of metacommunity ecology**. *Annals of the New York Academy of Sciences* 1469: 86-104. https://doi.org/10.1111/nyas.14378

Chaudhary, B. and Berhe, A.A. (2020). **Ten simple rules for building an anti-racist lab.** (Preprint) *EcoEvoRxiv*. https://doi.org/10.32942/osf.io/4a9p8

Cochrane, J.A. (2020). **Thermal requirements underpinning germination allude to risk of species decline from climate warming**. *Plants*, 9(6): 796. http://dx.doi.org/10.3390/plants9060796

Dalsgaard, B. (2020). **Land-use and climate impacts on plant–pollinator interactions and pollination services.** *Diversity*, 12(5): 168. https://doi.org/10.3390/d12050168

Eldridge, D.J., Oliver, I., Val, J. and Travers, S.K. (2020). **Limited evidence for the use of livestock for the conservation management of exotic plant cover.** *Australian Journal of Botany*, 68(2): 137-145. https://doi.org/10.1071/BT19183

Farrar, A., Kendal, D., Williams, K.J. and Zeeman, B.J. (2020). **Social and ecological dimensions of urban conservation grasslands and their management through prescribed burning and woody vegetation removal.** *Sustainability*, 12(8): 3461. https://doi.org/10.3390/su12083461

Fenollosa, E., Jené, L. and Munné-Bosch, S. (2020). **A rapid and sensitive method to assess seed longevity through accelerated aging in an invasive plant species.** *Plant Methods*, 16:1-11.

https://doi.org/10.1186/s13007-020-00607-3

Fensham, R.J., Carnegie, A.J., Laffineur, B., Makinson, R.O., Pegg, G.S. and Wills, J. (2020). **Imminent extinction of Australian Myrtaceae by fungal disease.** *Trends in Ecology and Evolution*. https://doi.org/10.1016/j.tree.2020.03.012

Fensham, R.J., Laffineur, B. and McVeigh, M. (2020). **Assessing the conservation status of tree species declining in productive landscapes: the case of *Eucalyptus argophloia*.** *Australian Journal of Botany, 68:* 119-126. https://doi.org/10.1071/BT20016

Fernandez-Winzer, L., Berthon, K.A., Entwistle, P., Manea, A., Winzer, N., Pegg, G.S., Carnegie, A.J. and Leishman, M.R. (2020). **Direct and indirect community effects of the invasive plant pathogen *Austropuccinia psidii*** (Myrtle Rust) **in eastern Australian rainforests.** *Biological Invasions*, 22: 1-13. https://doi.org/10.1007/s10530-020-02260-2

Fletcher, M.S., Hall, T. and Alexandra, A.N. (2020). **The loss of an indigenous constructed landscape following British invasion of Australia: An insight into the deep human imprint on the Australian landscape.** *Ambio*. https://doi.org/10.1007/s13280-020-01339-3

Foreman, P. (2020). **Historic archives are critical for reconstructing the nature and distribution of lowland temperate grasslands in south–eastern Australia.** *Cunninghamia* 20: 123–137 https://doi.org/10.7751/cunninghamia.2020.20.006

Green, J., Mooney, S. and Hemmings, F. (2020) **Reconstruction of the pre-European vegetation of Wolgan Valley, western Blue Mountains, NSW.** *Cunninghamia* 20: 139–152 https://doi.org/10.7751/cunninghamia.2020.20.007

Grimm, M. (2020). **Conserving biodiversity through offsets? Findings from an empirical study on conservation banking**. *Journal for Nature Conservation*, 57: 125871. https://doi.org/10.1016/j.jnc.2020.125871

Hines, H.B., Brook, M., Wilson, J., McDonald, W.J.F. and Hargreaves, J. (2020). **The extent and severity of the MacKay highlands 2018 wildfires and the potential impact on natural values, particularly in the mesic forests of the Eungella-crediton area.** *The Proceedings of the Royal Society of Queensland,* 125: 139.

Hirsch, H., Allsopp, M.H., Canavan, S., Cheek, M., Geerts, S., Geldenhuys, C.J., Harding, G., Hurley, B.P., Jones, W., Keet, J., Klein, H., Ruwanza, S., van Wilgen, B.W., Wingfield, M.J. and Richardson, D.M. (2019). ***Eucalyptus camaldulensis* in South Africa–past, present, future**. *Transactions of the Royal Society of South Africa*, 1-22. https://doi.org/10.1080/0035919X.2019.1669732

Hoban, S., Callicrate, T., Clark, J., Deans, S., Dosmann, M., Fant, J., Gailing, O., Havens, K., Hipp, A.L., Kadav, P. and Kramer, A.T. (2020). **Taxonomic similarity does not predict necessary sample size for *ex situ* conservation: a comparison among five genera.** *Proceedings of the Royal Society B*, 287(1926): 20200102. https://doi.org/10.1098/rspb.2020.0102

Hunter, J.T., (2020). **Grasslands on Coastal Headlands in New South Wales, south eastern Australia.** *Vegetation Classification and Survey*, 1: 111. https://doi.org/10/3897/VCS/2020/48228

Hunter, J.T. and Hunter, V.H., (2020). **Montane mire vegetation of the New England Tablelands Bioregion of Eastern Australia.** *Vegetation Classification and Survey*, 1: 37. https://doi.org/10.3897/VCS/2020/48765

İri, F.G. and Çil, E., (2020). **Attitudes toward plants: comparing the impact of instruction through riting and through a botanical garden trip.** *The American Biology Teacher*, 82(4): 218-226. https://doi.org/10.1525/abt.2020.82.4.218

Laws, C.A., Hancock, N. and Leishman, M.R. (2020). **Using the scientific listing process to better understand climate change risk to threatened species and ecological communities in New South Wales.** *Pacific Conservation Biology*, 26(2), pp.173-181. https://doi.org/10.1071/PC19021

Liyanage, G.S., Offord, C.A. and Sommerville, K.D. (2020). **Techniques for breaking seed dormancy of rainforest species from genus Acronychia.** *Seed Science and Technology*. 48(1). https://doi.org/10.15258/sst.2020.48.2.03

Marinho, L.C. and Beech, E. (2020). **How phantom databases could contribute to conservation assessments.** *Die Naturwissenschaften*, 107(3): 21. https://doi.org/10.1007/s00114-020-01679-w

McNellie, M.J., Oliver, I., Dorrough, J., Ferrier, S., Newell, G. and Gibbons, P. (2020). **Reference state and benchmark concepts for better biodiversity conservation in contemporary ecosystems.** (Preprint) Website: *www.preprints.org*. https://doi.org/10.20944/preprints202007.0093.v1

Quang, P.M., Baynes, J. and Herbohn, J. (2020). **The effect of overwood competition on the long-term survival, growth and stocking of underplanted tree species in logged tropical rainforest in north Queensland, Australia.** *Forest Ecology and Management*, 472, p.118241. https://doi.org/10.1016/j.foreco.2020.118241

Paseka, R.E., White, L.A., Van de Waal, D.B., Strauss, A.T., González, A.L., Everett, R.A., Peace, A., Seabloom, E.W., Frenken, T. and Borer, E.T. (2020). **Disease-mediated ecosystem services: Pathogens, plants, and people.** *Trends in ecology and evolution.* 35(8): 731-743. https://doi.org/10.1016/j.tree.2020.04.003

Prahalad, V., Kirkpatrick, J.B., Aalders, J., Carver, S., Ellison, J., Harrison-Day, V., McQuillan, P., Morrison, B., Richardson, A. and Woehler, E. (2020). **Conservation ecology of Tasmanian coastal saltmarshes, south-east Australia–a review.** *Pacific Conservation Biology*, 26(2): 105-129. https://doi.org/10.1071/PC19016

Pye, S. (2020). **The power of nonfiction life story narratives to communicate conservation to a non-specialist audience.** *The Anthropocene Review*, 7(2): 113-124. https://doi.org/10.1177/2053019620916492

Selinske, M.J., Garrard, G.E., Gregg, E.A., Kusmanoff, A.M., Kidd, L.R., Cullen, M.T., Cooper, M., Geary, W.L., Hatty, M.A., Hames, F. and Kneebone, S. (2020). **Identifying and prioritizing human behaviours that benefit biodiversity**. *Conservation Science and Practice*, e249. https://doi.org/10.1111/csp2.249

Sievers, M., Pearson, R.M., Turschwell, M.P., Bishop, M.J., Bland, L., Brown, C.J., Tulloch, V.J., Haig, J.A., Olds, A.D., Maxwell, P.S. and Connolly, R.M. (2020). **Integrating outcomes of IUCN red list of ecosystems assessments for connected coastal wetlands.** *Ecological Indicators*, 116: 106489. https://doi.org/10.1016/j.ecolind.2020.106489

Rees, M.W., Carwardine, J., Reeson, A. and Firn, J. (2020). **Rapidly assessing cobenefits to advance threat-management alliances.** *Conservation Biology*. https://doi.org/10.1111/cobi.13490

Tangney, R. Merrit, D.J., Callow, J.N., Fontaine, J.B and Miller, B.P. (2020). **Seed traits determine species' responses to fire under varying soil heating scenarios**. *Functional Ecology* https://doi.org/10.1111/1365-2435.13623

Tierney, D.A., Ahrens, C., Rymer, P. and Auld, T.D. (2020). **The interaction of clonality, breeding system and genomics for a highly threatened plant species and the management implications**. *Biodiversity and Conservation*, 29: 3009-3029. https://doi.org/10.1007/s10531-020-02012-7

Urban, M.C. (2020). **Climate-tracking species are not invasive.** *Nat. Clim. Chang.* 10: 382–384. https://doi.org/10.1038/s41558-020-0770-8

Verhoeven, E.M., Murray, B.R., Dickman, C.R., Wardle, G.M. and Greenville, A.C. (2020). **Fire and rain are one: extreme rainfall events predict wildfire extent in an arid grassland.** *International Journal of Wildland Fire*. https://doi.org/10.1071/WF19087

Walker, B.E., Leão, T.C., Bachman, S.P., Bolam, F.C. and Nic Lughadha, E. (2020). **Caution needed when predicting species threat status for conservation prioritization on a global scale.** *Frontiers in Plant Science*, 11: 520. https://doi.org/10.3389/fpls

Ward, B., Wills, A. and Tunsell, V. (2020). **Silviculture and fire effects on understorey flowering in jarrah forest**. *Australian Forestry*, https://doi.org/10.1080/00049158.2020.1787935

Watson, G.M., French, K. and Collins, L. (2020) **Timber harvest and frequent prescribed burning interact to affect the demography of Eucalypt species.** *Forest Ecology and Management*, 475: 118463. https://doi.org/10.1016/j.foreco.2020.118463

Worthy, S.J., Laughlin, D.C., Zambrano, J., Umaña, M.N., Zhang, C., Lin, L., Cao, M. and Swenson, N.G. (2020). **Alternative designs and tropical tree seedling growth performance landscapes.** *Ecology*, p.e03007. https://doi.org/10.1002/ecy.3007

Xi, X., Yang, Y., Tylianakis, J.M., Yang, S., Dong, Y. and Sun, S. **(**2020). **Asymmetric interactions of seed-predation network contribute to rare-species advantage.** *Ecology*, p.e03050**.** https://doi.org/10.1002/ecy.3050

Yare, B., Bell, S. and Hunter, N. (2020). **Phenology of the threatened *Diuris praecox* (Orchidaceae), a range-restricted terrestrial orchid from central eastern New South Wales.** *Cunninghamia* 20: 105-113. https://doi.org/10.7751/cunninghamia.2020.20.004

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Image: *Acacia terminalis* subsp. *terminalis* (credit Gavin Phillips, Royal Botanic Gardens Sydney).

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